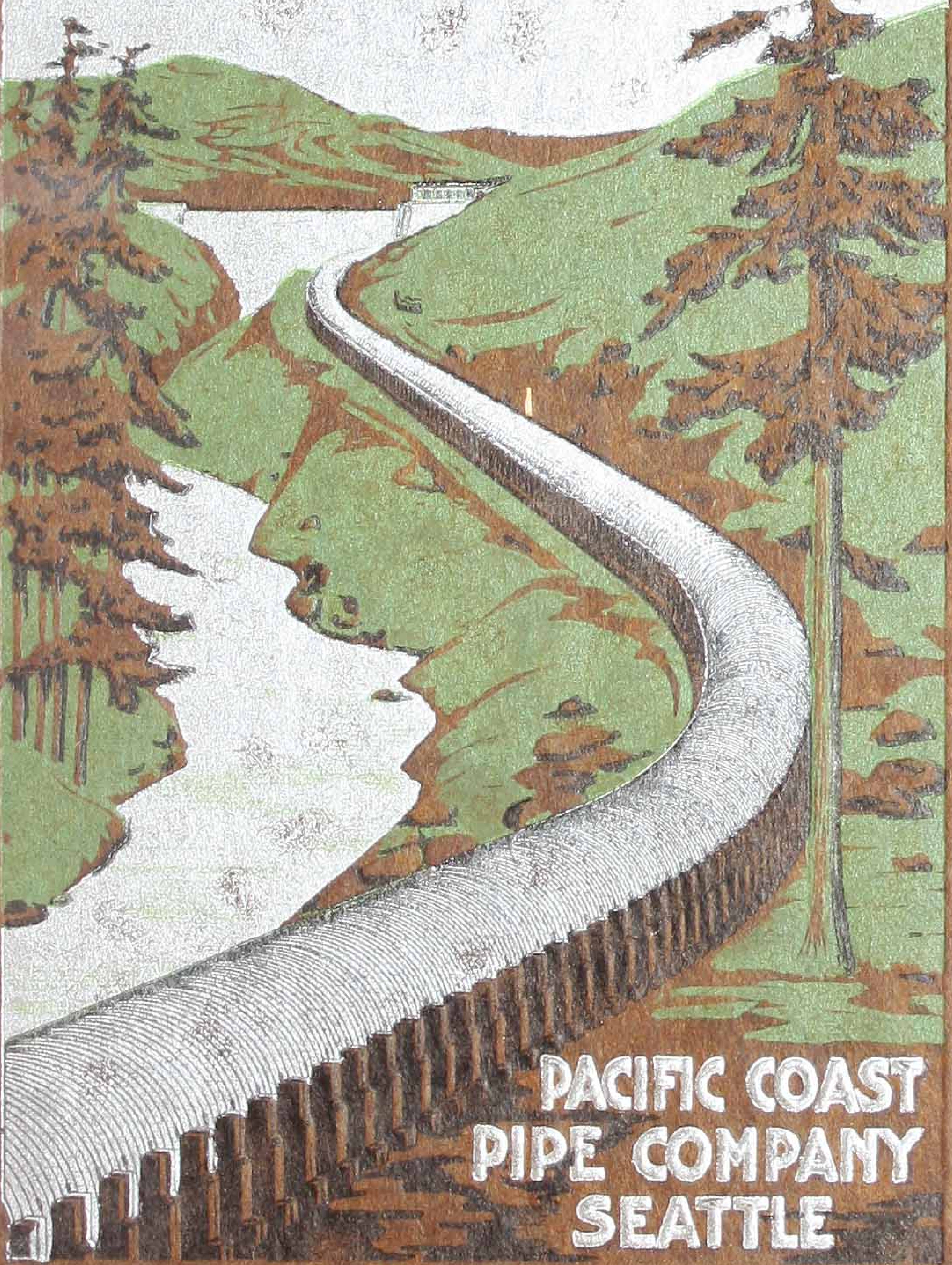
633-7

CONTINUOUS STAVE PIPE



PACIFIC COAST
PIPE COMPANY
SEATTLE

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CONTINUOUS STAVE PIPE INSTALLATIONS

PACIFIC COAST PIPE CO.

Seattle, Washington.

T. B. Garrison - - - - - - *President and Gen. Manager*
J. C. Ralston, M. Am. Soc. C. E. - - - *Vice-President*
E. R. Week - - - - - - - - - - - - - *Secretary*
W. J. C. Wakefield - - - - - - - - - - *Treasurer*

L. M. Grant, Assoc. M. Am. Soc. C. E. - - *Chief Engineer*

FORENOTE

THE illustrations and brief text on the following pages are intended to give a general conception of the types, sizes and characteristics, as well as the territorial range of our Continuous Stave Wood Pipe installations for power, irrigation and municipal service. They are typical, although necessarily incomplete, by reason of the size of this album.

In our work we endeavor to see that each installation with which we are connected is designed and constructed in strict accordance with the requirements of all the hydraulic functions involved. To this end we have on our staff competent and experienced engineers, members of the American Society of Civil Engineers, who go over each proposed plan critically, and who are always willing to suggest to the project engineer any modifications in the preliminary plans which, in their experience, seem necessary to give the most efficient installation.

These suggestions are often of value to engineers who, although entirely qualified, may not be familiar with all the structural details of wood stave pipe. This service has met with the cordial endorsement of our customers, since it has generally resulted in a reduced cost to the buyer.

We have made a specialty of Continuous Stave Pipe for many years and in modest pride point to the fact that since the beginning of 1909, we have installed the largest amount of Continuous Stave Wood Pipe of any manufacturer on the Continent. We also have the distinction of having installed the largest size wood pipe in the World (one hundred and sixty-two inches in diameter).

These facts, together with the wide range of our experience, the efficiency of our organization and equipment, and the strength of our financial standing, will invite, we are persuaded, inquiries about new projects, while the uniform excellence of our installations will retain the patronage of our many customers.

TO ENGINEERS

BEGINNING in the fall of 1909, Atlantic City, N. J., built a 48″ Continuous Stave Wood Pipe line 25,500 feet long across the salt marsh over which the several metal pipe lines of the past have been failures. In a paper by Mr. George L. Watson, Consulting and Supervising Engineer for the General Contractor of that line, published in Vol. IV, No. 7, September, 1912, Journal of the American Society of Engineering Contractors, he concludes that excellent article with a warning to all general contractors to keep hands off and leave all wood pipe to a regular pipe contractor. He says:

"If we merely look at photographs of the completed work, the building of a wood pipe line appears to be a very simple form of construction; perhaps to some engineers and construction men it is. The writer is very chary about giving advice gratis, for what we get for nothing is not valued at much; but still a word of advice may not be amiss. The contractor who is fortunate, or unfortunate, enough to be awarded a contract for laying a wood pipe line should first—and this is most important—get one of the stave manufacturers or wood pipe construction firms established in the West to bid a price for doing all the pipe work. If then he should reject the lowest bid from that source, for which he will afterward be truly sorry, let the contractor make sure of a man who can organize and handle this work and who has had experience in laying different kinds of pipe under varying conditions, that is, pressure lines, laid in locations that are not favorable to wood pipe. At any rate the experienced pipe constructor should first be consulted, and by doing so the contractor who may be tempted to bid on work of this kind will often be protected against heavy loss."

This is not an unusual experience, and many similar instances have arisen where either the principal or his general contractor has come to us for relief.

As this matter is being prepared for the press, we have been called upon to send one of our construction men to **pull down** and **rebuild** an extension to one of our pipe lines, the erecting of which had

been unsuccessfully attempted by the general foreman of the irrigation company in question.

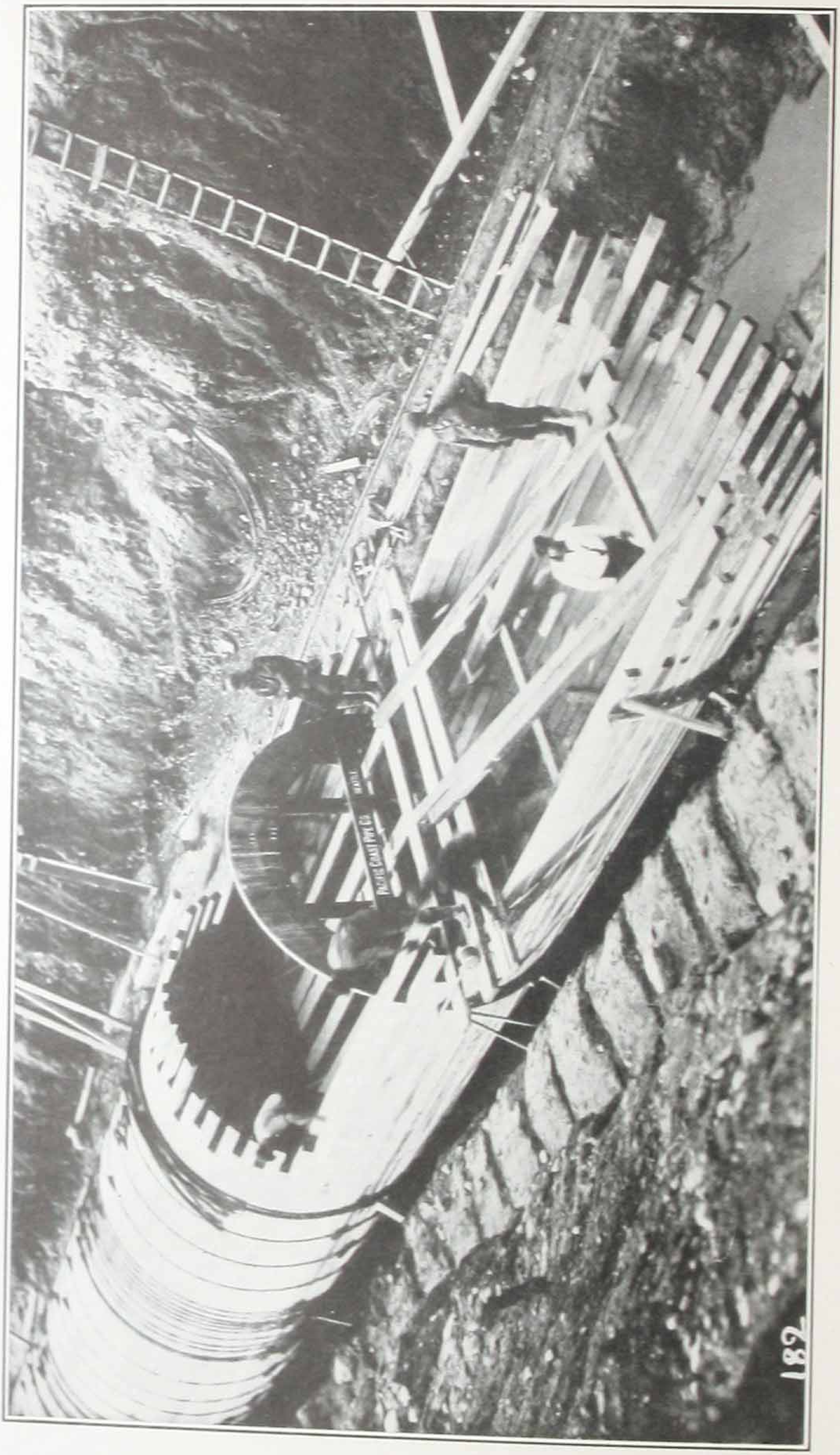
We are vitally interested in doing all we can to secure first-class installations no matter by whom they may be made, for every foot of poor wood pipe installed is not only a reflection on its builder, but also a black eye to the industry as a whole.

We believe ourselves to be experts in designing, manufacturing and erecting, and consequently it follows that we can install any wood pipe line more cheaply, more quickly and in a more workmanlike manner than can any general contractor who, by the very nature of things, cannot give undivided personal attention to this the major artery of an hydraulic project, and whose reputation does not depend on this one class of construction.

We are purchasers, year in and year out, of the largest quantities of the best stave stock produced, and hence our buying facilities and overshadowing command of that market give us an advantage which the general contractor, necessarily, cannot enjoy.

By reason of its wide range of adaptability, ease of delivery and distribution, flexibility, low frictional resistance to flow, and low cost, wood pipe is being received with marked favor by the leading Engineers throughout the country. Many of the largest corporations in the United States and Canada are installing this pipe, and our present range of distribution extends from the Pacific to the Atlantic, as well as to the Orient.

Strange as it may seem, one of the most enthusiastic supporters of wood pipe for power purposes is a very large iron and steel corporation for whom we made an installation in which our pipe was put on a comparative basis with steel, the outcome being greatly to our advantage.



OSWEGO COUNTY, NEW YORK

THIS is a construction view of a Continuous Stave Wood Pipe Power Line near Altmar, N. Y., installed by us for the Erie Construction Co.—a subsidiary of the Ontario Power Co. of Niagara Falls. The line consists of 3450 feet of 144″ and 4400 feet of 132″ wood pipe, and is banded for a maximum head of 150 feet. It serves an initial power generation of 15,000 H. P., with an ultimate development of 20,000 H. P.

The lower end of the 11′-0″ wood pipe is connected to 11′-6″ riveted steel pipe, the change being warranted because of the lesser cost of this size of steel under higher heads than 150 feet in this territory. The increased diameter of the steel pipe partially equalizes the difference in friction loss between wood and steel.

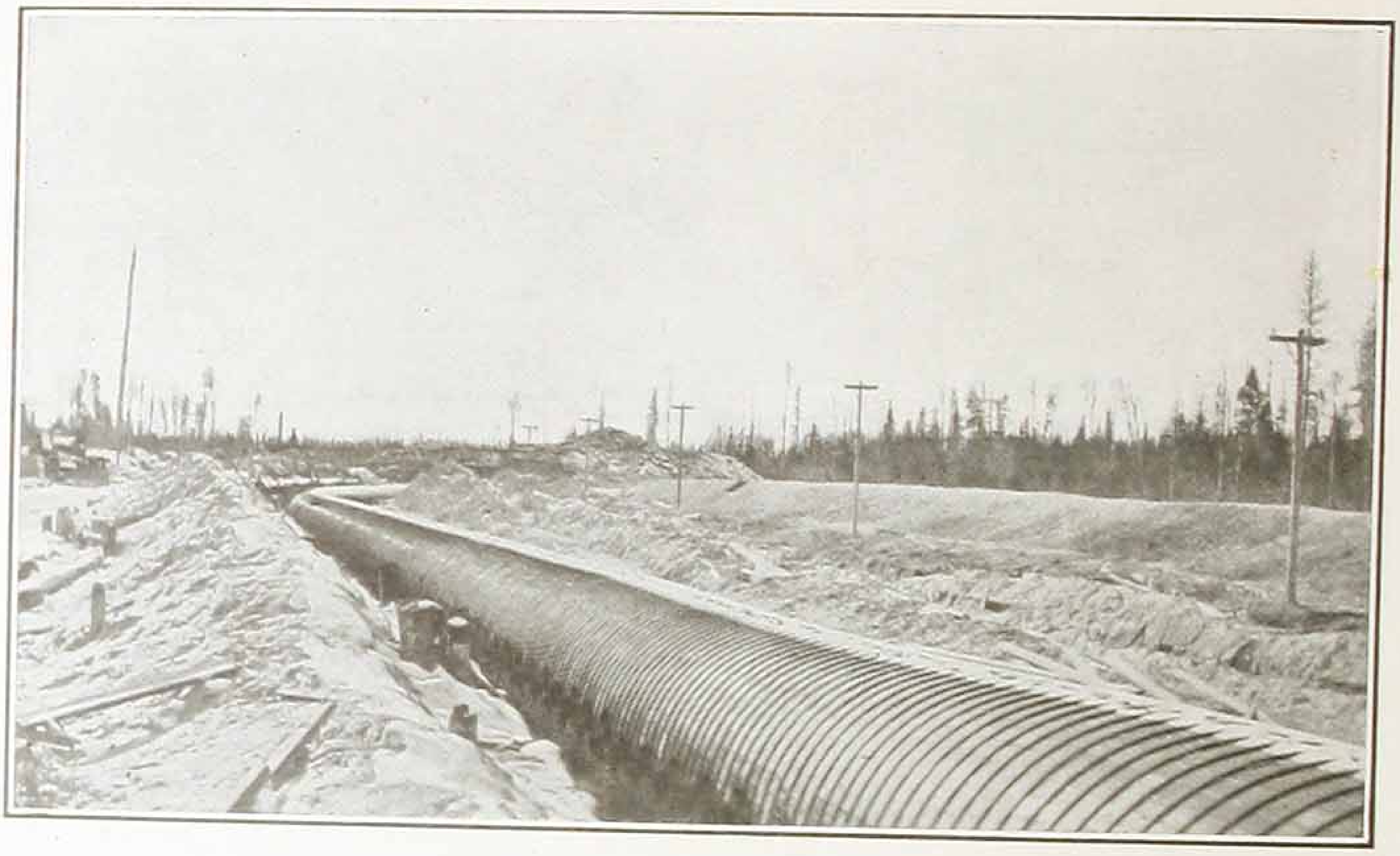
The two stave sections are connected by a long taper reducer of wood. Thus the transition from one size wood pipe to the other is made without appreciable loss of head.

The 12′ line was thoroughly coated on the outside after erection with genuine Avenarius Carbolineum as a precaution against decay spores getting a start during seasons of low water when the head on the line may become so low as not to give complete saturation. This application was made at our suggestion and is, we believe, the first time Carbolineum has been used in this connection.

Barclay Parsons and Klapp, 60 Wall St., New York, were the engineers in charge.

———o———

WRITE US FOR ESTIMATES ON YOUR PIPE REQUIREMENTS, GIVING US THE INFORMATION ASKED FOR ON PAGE 27.



Note the portable shanty over the end of the wood pipe below to enable the pipe builders to work in below zero weather

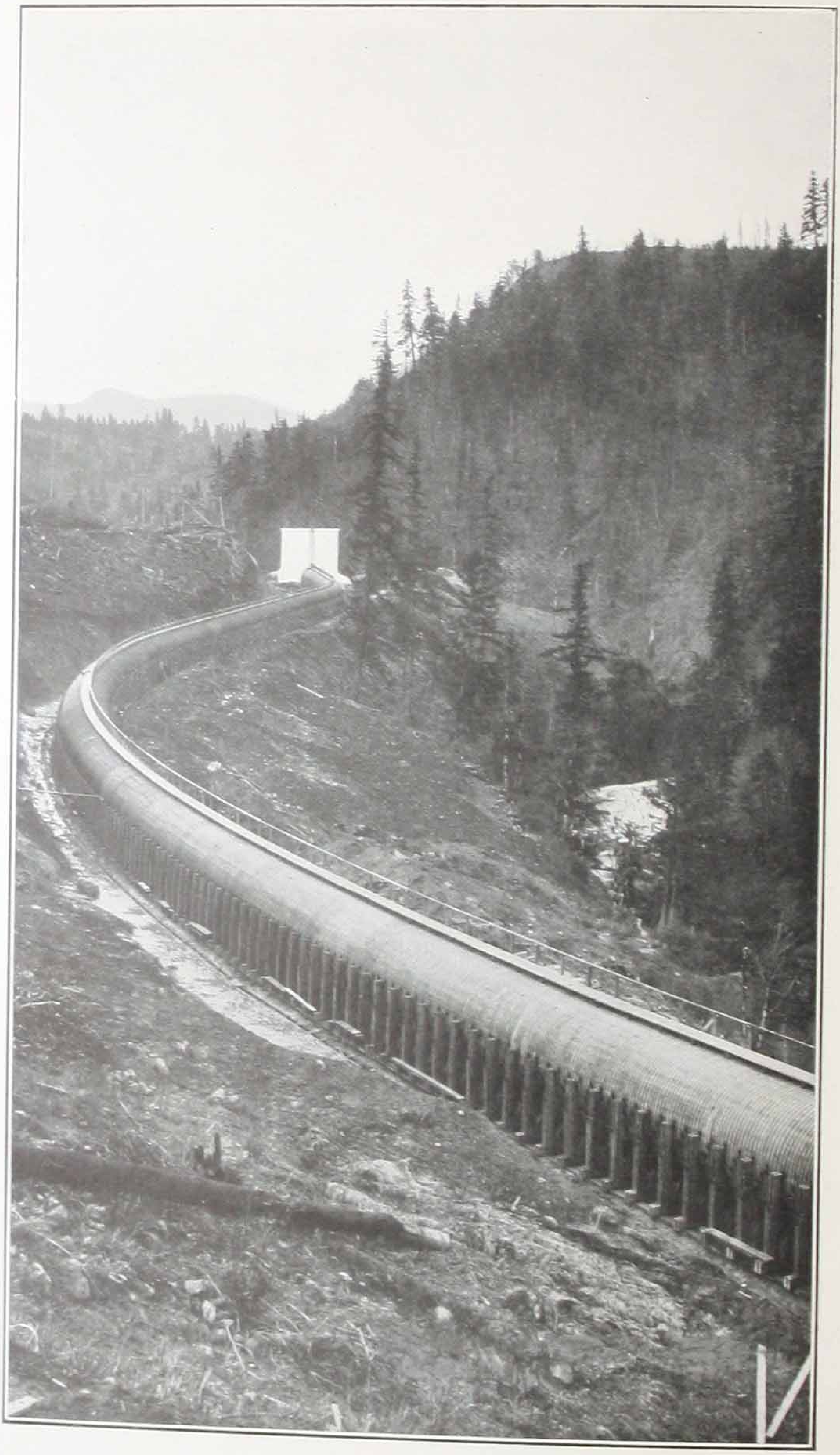
ONTARIO, CANADA

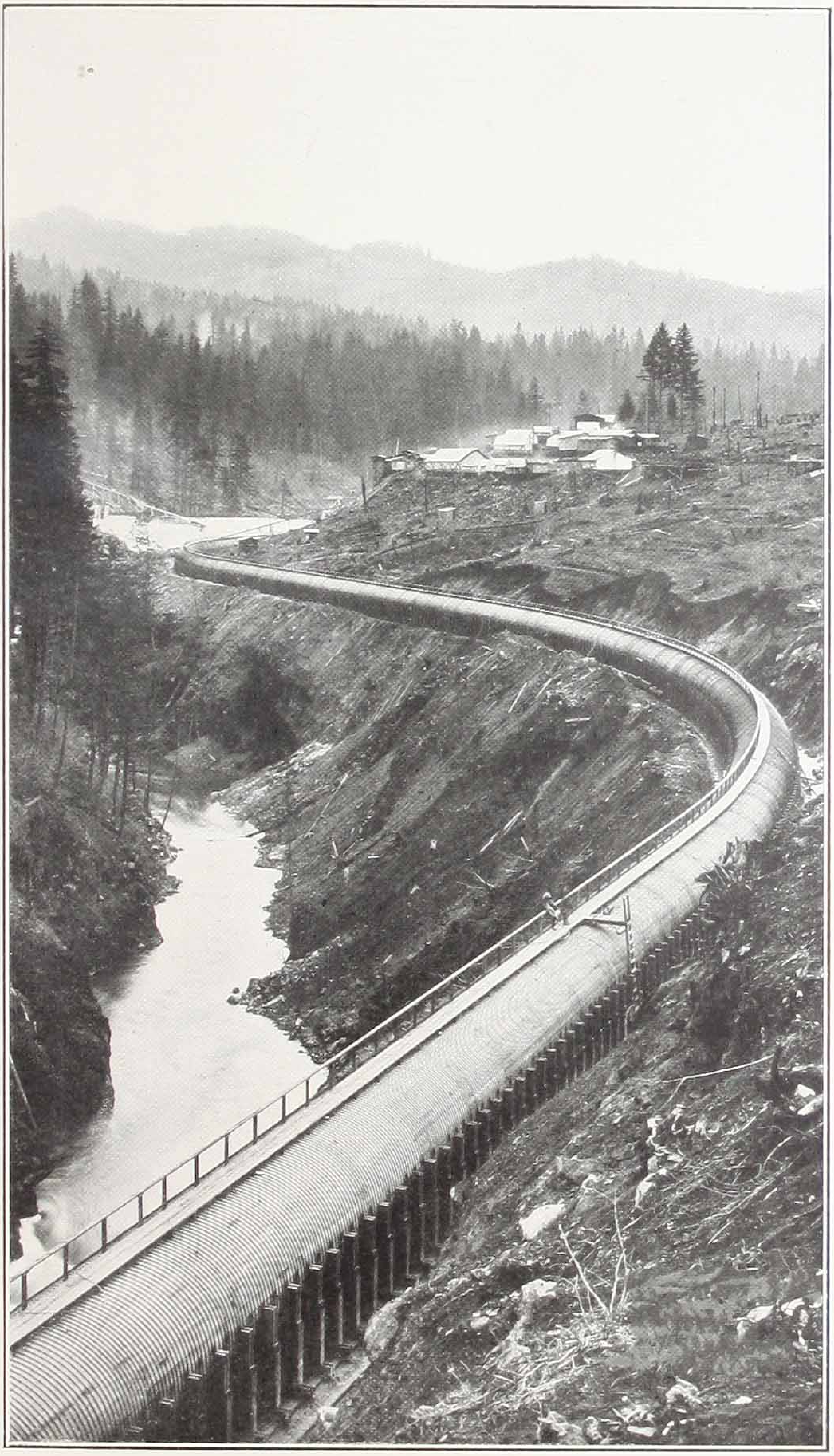
THE views opposite show a Continuous Stave Pipe Line 108″ in diameter, installed for the Northern Canada Power Co. Ltd., near Timmins, Ontario. This wood stave line was installed to replace the riveted steel line shown to the left in the lower view. The steel pipe failed because of unequal settlement. The wood pipe is flexible enough to adjust itself to any such inequalities, and even if minor leaks develop during settlement, they are easily repaired without draining the line.

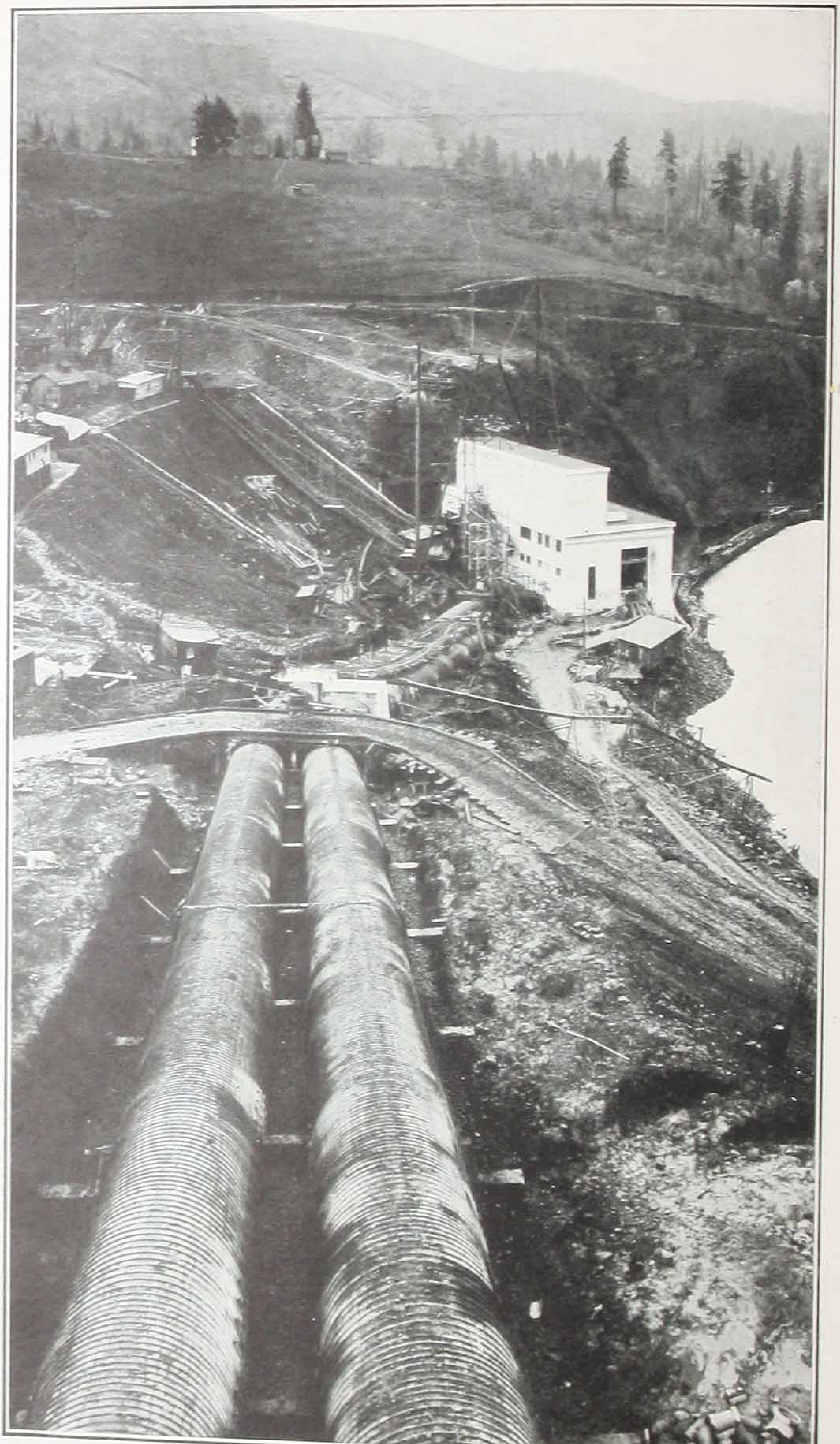
This being an emergency installation, work was completed during severe winter weather, as the pictures suggest. The stream upon which this development is located is tributary to Hudson Bay.

This work was done under the supervision of Viele, Blackwell and Buck, Engineers, 49 Wall St., New York.

On Page 48 you will find a diagram from which the discharge, velocity and friction loss of our wood pipe for any diameter from two to fourteen feet may readily be determined without computation.







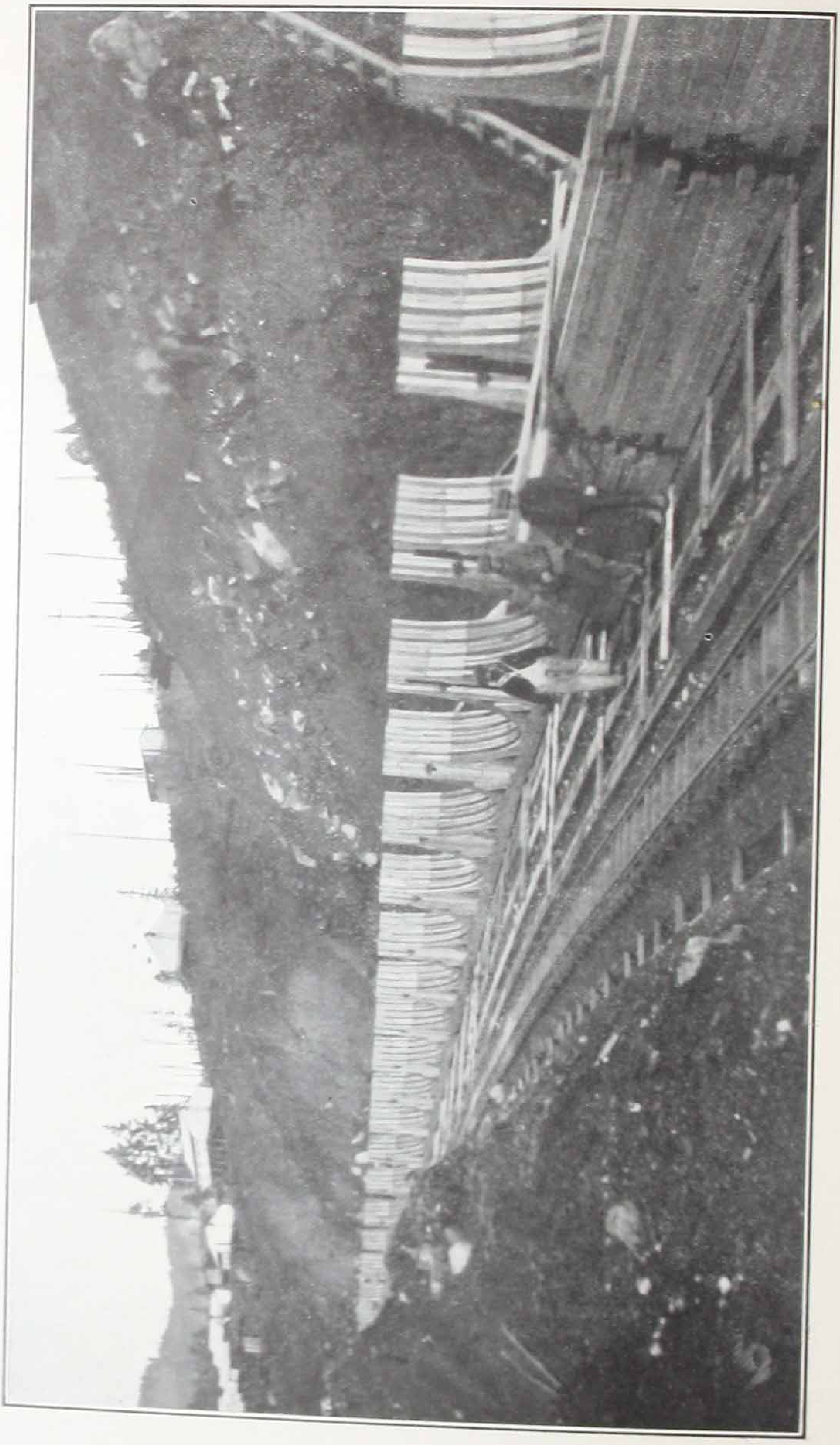
WASHINGTON

THE views on Pages 10, 11 and 12 show the largest Continuous Stave Wood Pipe in the WORLD. This installation was made by us for the Northwestern Electric Co. of Portland, Oregon, under the supervision of the Stone & Webster Engineering Corporation of Boston, who were general contractors on the work. It is a part of the Condit Plant which is a hydro-electric development on the White Salmon River, a north bank tributary of the Columbia about seventy miles above Portland.

Our installation consists of a mile of wood stave flow line 162″ (13′-6″) in diameter conveying the water from the dam to a concrete surge tank and forebay; also twin wood stave penstocks, 108″ in diameter and 600′ long, from the surge tank to the powerhouse. The normal capacity of the system is 1230 cu. feet per sec., velocity 8.6′ per sec., maximum static head on wood pipe 154′, wheel capacity 20,000 H. P.

The 13′-6″ line is supported throughout its entire length on timber cradles spaced about 4′-6″ center to center. When it is considered that the static water load amounts to nearly 9,000 lbs. per running foot and that the average weight of the pipe itself is 700 lbs., it will be seen that each cradle has a load of nearly 22 tons. This load is a half greater than that imposed by the heaviest locomotive of today, and necessitates careful study in the design of cradles and supports.

As an example of what can be done by a careful selection of materials and skilled labor under competent supervision, it is worthy of note that one unit in the power house was turning over in less than six hours after water was admitted to the pipe line at the dam and that, in so far as the wood pipe is concerned, no reason for emptying the line has existed since the water was first admitted.



WASHINGTON

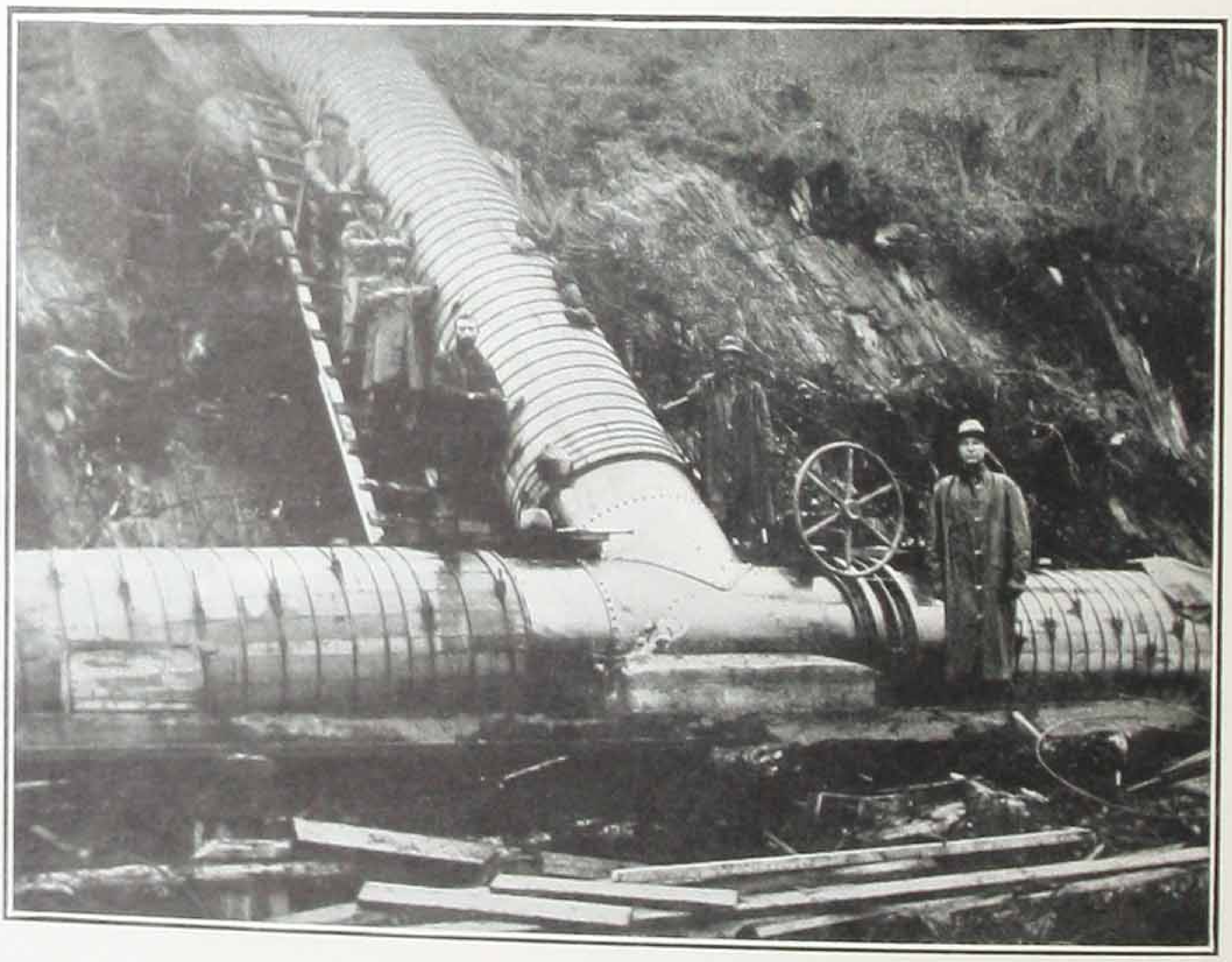
THE view on the opposite page shows pipe cradles and staves for the 13′-6″ pipe described on Page 13, as they were distributed along the grade ready for the pipe builders, by means of a "dinky" on the narrow gauge track shown. After the bands and shoes had also been placed along the grade in proper quantities, the track was taken up, cradles swung into place on mudsills already set, and the assembling started. Thus all pipe materials were spotted in an orderly and convenient manner, adjacent to their respective places in the finished structure. All unnecessary handling was consequently avoided.

The cradles used on this contract are worthy of note since the lateral stress or spreading tendency of the pipe is taken up by truss rods, thus reducing the length of the bottom member to a minimum. This reduces the required width of the grade and the yardage very materially.

The replacement of these timber cradles in eight to ten years by permanent concrete cradles is anticipated. This can be done with the pipe line in commission and will give the best results, since there will be no initial settlement to guard against.

Installations in which the pipe is supported on cradles so as to keep the staves and bands entirely free from the soil and open to inspection, undoubtedly give the best results both in respect to length of serviceable life and low maintenance. The added cost of cradles is often about counterbalanced by the saving in excavation and backfill.

Full description of this installation may be found in the Engineering News of Oct. 9th, 1913, and Engineering Record of Oct. 11th, 1913.

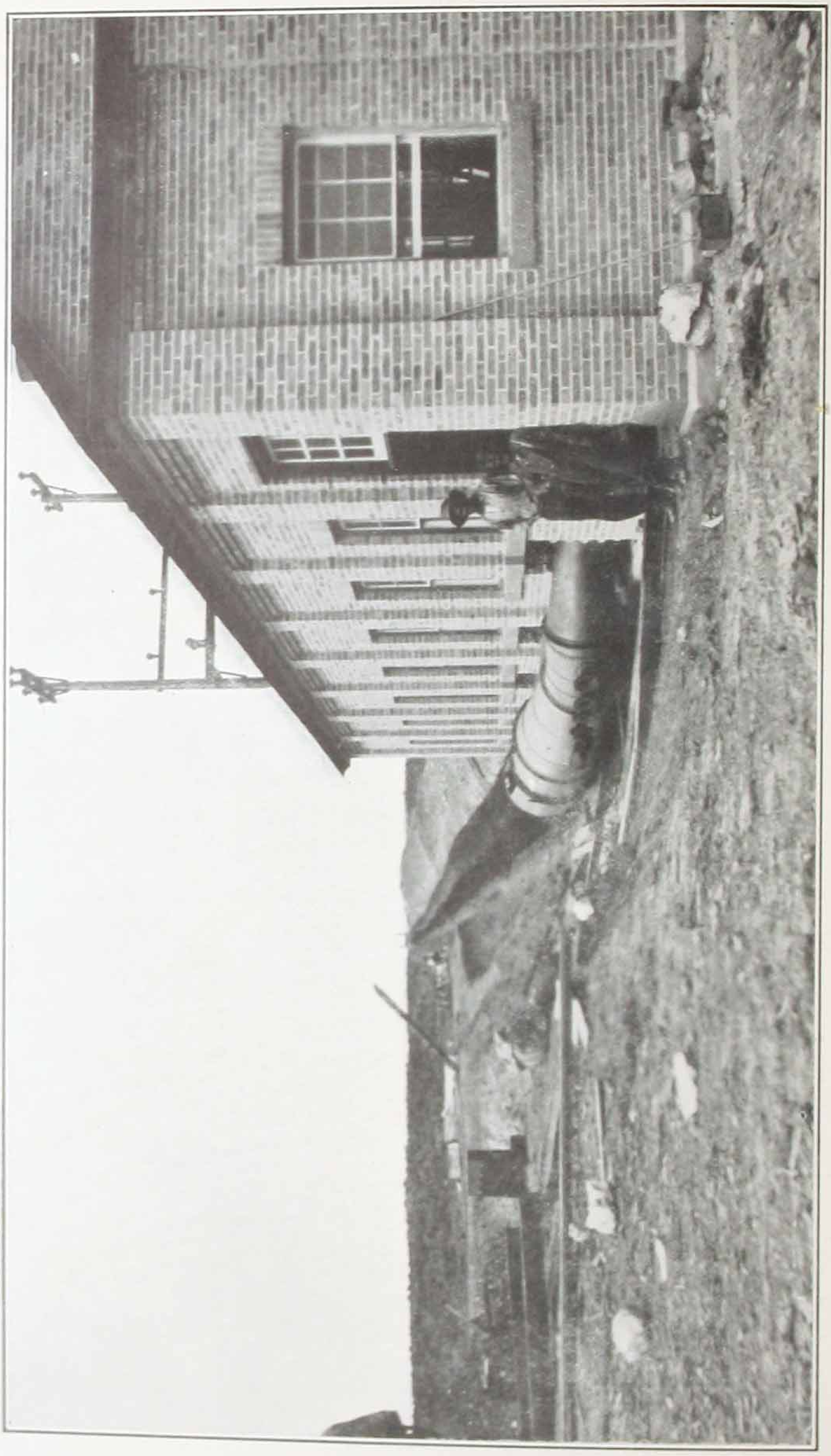


ALASKA

THE upper view on the opposite page shows a 42″ and 48″ Continuous Stave Wood Pipe line installed by us for the Citizens Light, Power and Water Co., at Ketchikan, Alaska, for power purposes. The greater part of the line is carried on low trestle. Wood stave is the only type of pipe adapted to the winter rigors of the far north, unless elaborate and expensive precautions are taken for protection against frost.

The lower view shows a surge pipe line in this Alaska line which is carried to the proper elevation by being laid up the adjacent hillside to the maximum level of the water behind the dam. The method of connecting through a steel tee special to the penstock is shown, together with the butterfly valve on the powerhouse side. The connection between the wood pipe and the steel special is made by simply cinching the staves on the outside of the tee ends. The seam rivets are countersunk on the outside of that portion of the fitting which is inserted into the wood pipe.

A surge pipe or adequate relief valves should be provided near the power house on all penstocks of any considerable length, in order to relieve the pipe line and wheel gates from destructive water hammer due to sudden changes in the velocity of the water passing the wheels.



IDAHO

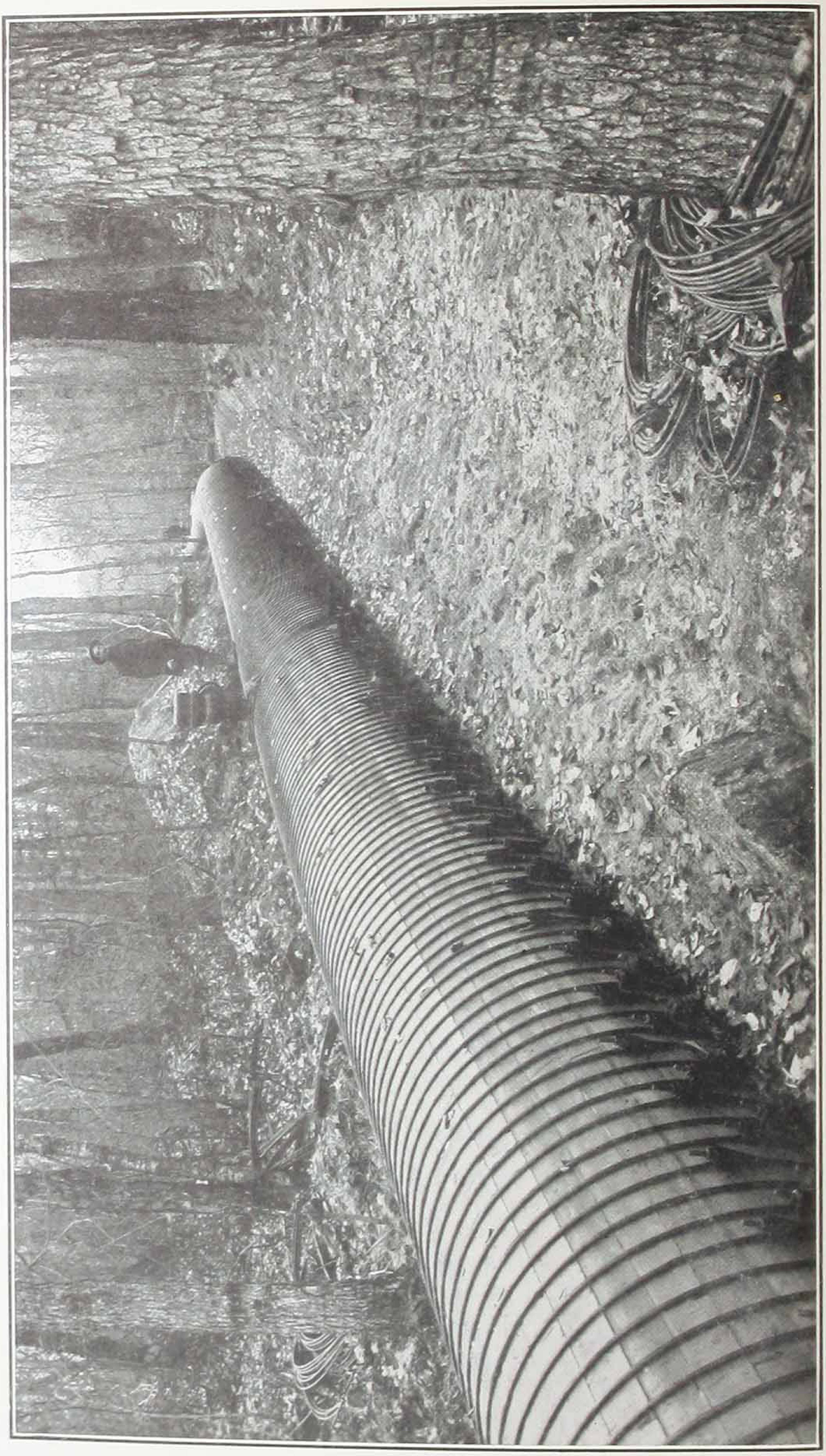
ON the opposite page we show a 50" Continuous Stave Pipe in use as a pump discharge from one of the pump stations of the Twin Falls North Side Land & Water Co. A similar 40" line is carried from the other side of the station to a canal system on a different level.

The method of connecting to the pumps by steel specials and the general station lay-out are typical of high-class electric driven installations of this kind.

On your pumping installation the annual cost of the power is a very important item. If you will take into consideration that, under average velocity conditions in pump discharge mains, the friction loss in riveted steel pipe is about 30 per cent. greater than in wood stave pipe of the same diameter, this perpetual saving in power in itself is ample justification for the installation of our pipe without considering its many other advantages.

Do you realize that although excessive water hammer in pump discharge lines, due to an accidental "dead end," may temporarily start seams in our stave pipe, it is practically impossible to burst it, because of the elasticity of the wood shell?

If you learn of a wood stave line that has apparently given poor service, be fair minded enough to investigate the cause carefully before condemning wood pipe in general, and don't fail to learn by whom it was installed.



MICHIGAN

THIS halftone illustrates a 60" Continuous Stave Wood Pipe installed by us for the Cleveland Cliffs Iron Co., near Marquette, Michigan, on their Carp River power development.

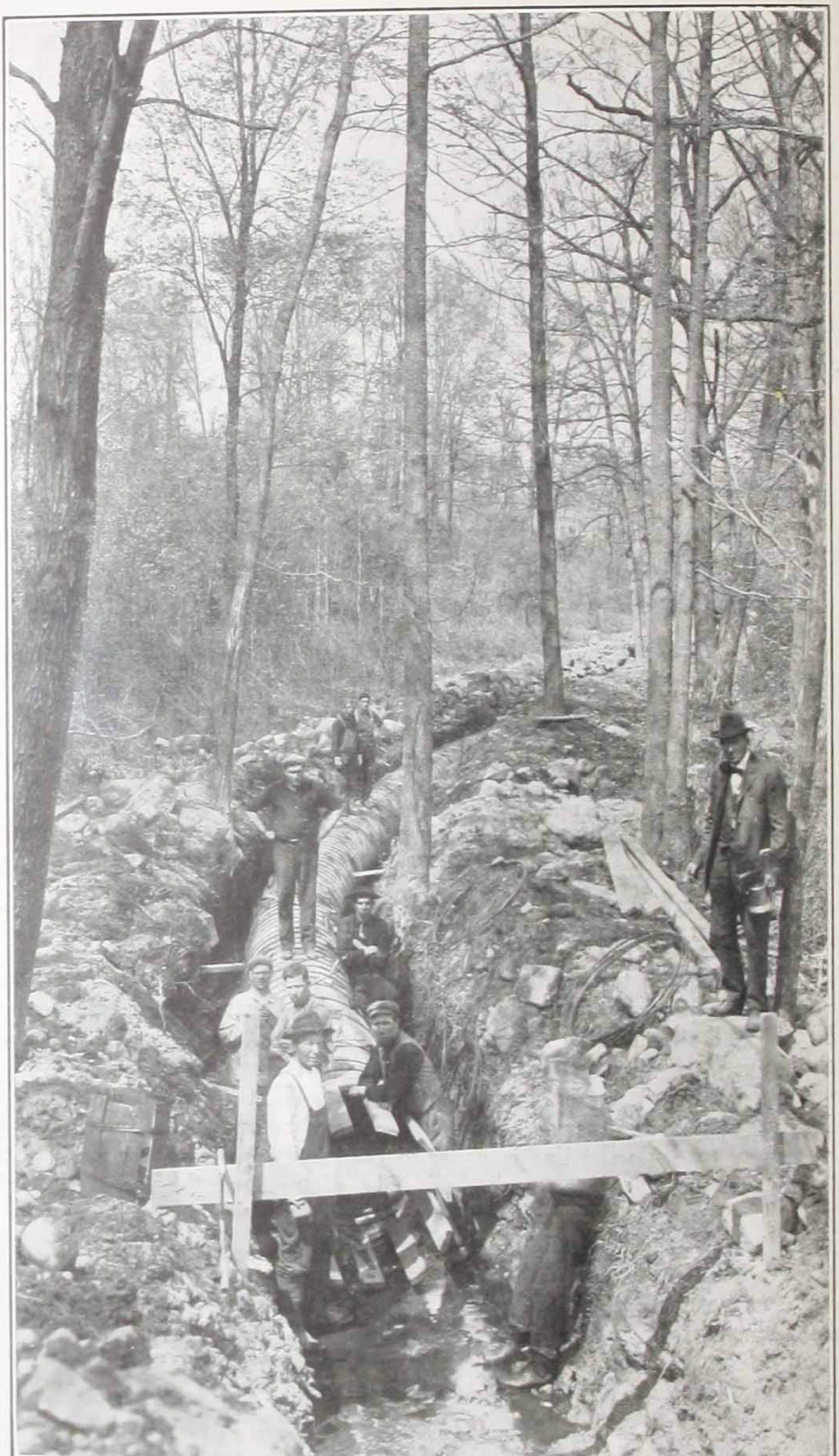
Our pipe was installed wherever the head was 175' or less. For the next higher heads lock-bar steel was used, changing at the lower end to imported seamless welded. The steel pipe installed is six inches larger in diameter than the wood to EQUALIZE FRICTION LOSSES. The average working head on the wheels is 580 feet, generating 5000 K. W.

Absolutely no trouble was experienced with the wood pipe under test. Its performance was so satisfactory that regret was expressed by the purchasers that our pipe had not been used to higher heads, as was recommended by us.

This plant was designed by Viele, Blackwell and Buck, Engineers, 49 Wall St., New York. A good description of it may be found in the Engineering Record of Nov. 23, 1912, Vol. 66, Page 574.

During the test of this line it became necessary to leave the wood pipe and a portion of the steel filled with dead water while seams were being caulked on some sections of the steel pipe. The weather conditions were very severe in this region during the winter of 1911-1912, when this work was completed, and for forty-eight hours the water stood in the pipe with the thermometer at ten degrees below zero. It was found necessary to drain the line in order to complete repairs on the steel pipe. Our Resident Engineer took flash-light pictures of the ice conditions found in the two classes of pipe upon emptying, which we have reproduced on Page 23 with an explanatory sketch. Both classes of pipe were backfilled to about the horizontal diameter and in addition a bell hole was excavated at the round-about joints of the steel to permit of field riveting.

Note that the ice in the steel pipe was from 6 to 15 inches thick, while in the wood pipe only a trace is to be found at the extreme top. This property of our pipe is conspicuously valuable in cold climates, since it permits of the location of pipe above ground without a frost jacket.

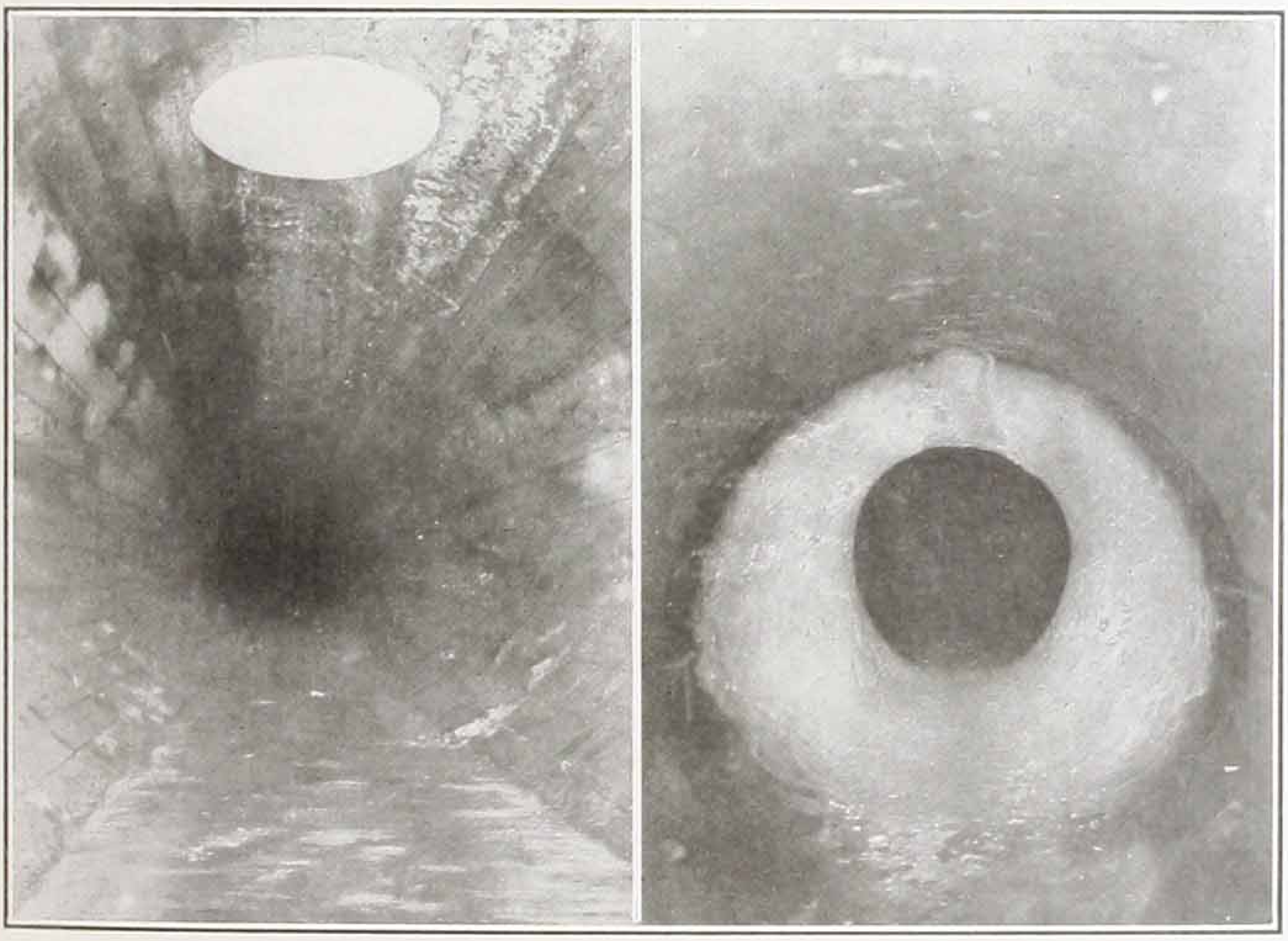


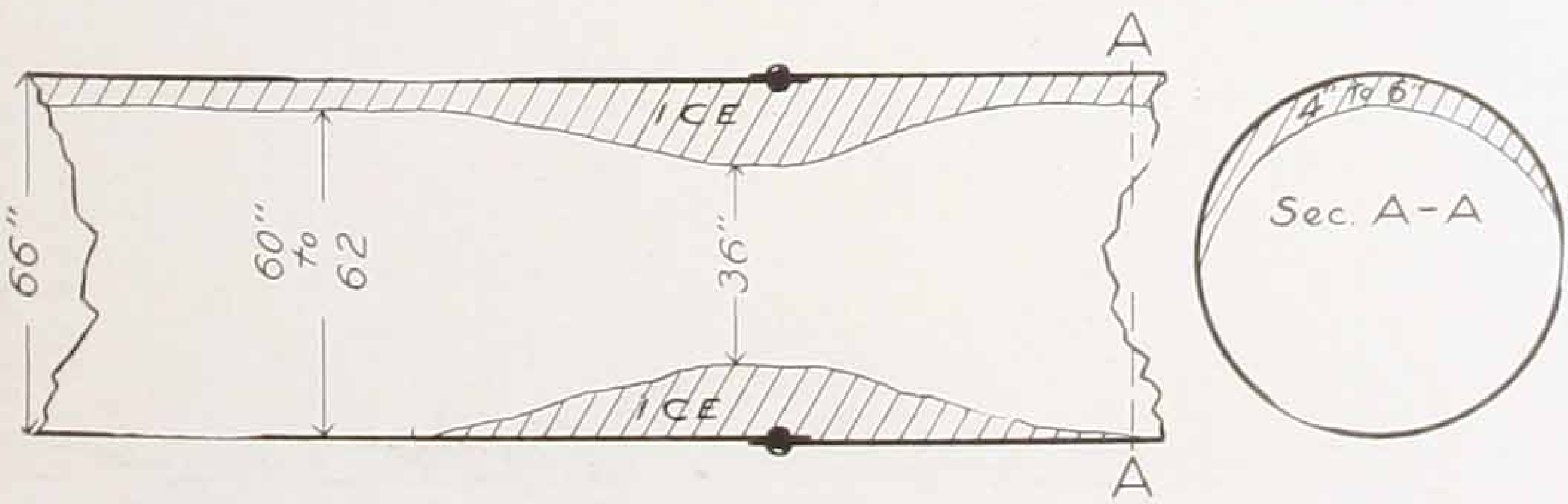
CONNECTICUT

ANOTHER one of our 36″ power lines of Continuous Stave Wood Pipe, near Waterbury, Conn. The waters carried in this line are heavily charged with the waste acids of the many metal pickling works of this region. These acids are destructive to metal pipe, but entirely harmless to wood pipe, which is the logical installation for such conditions.

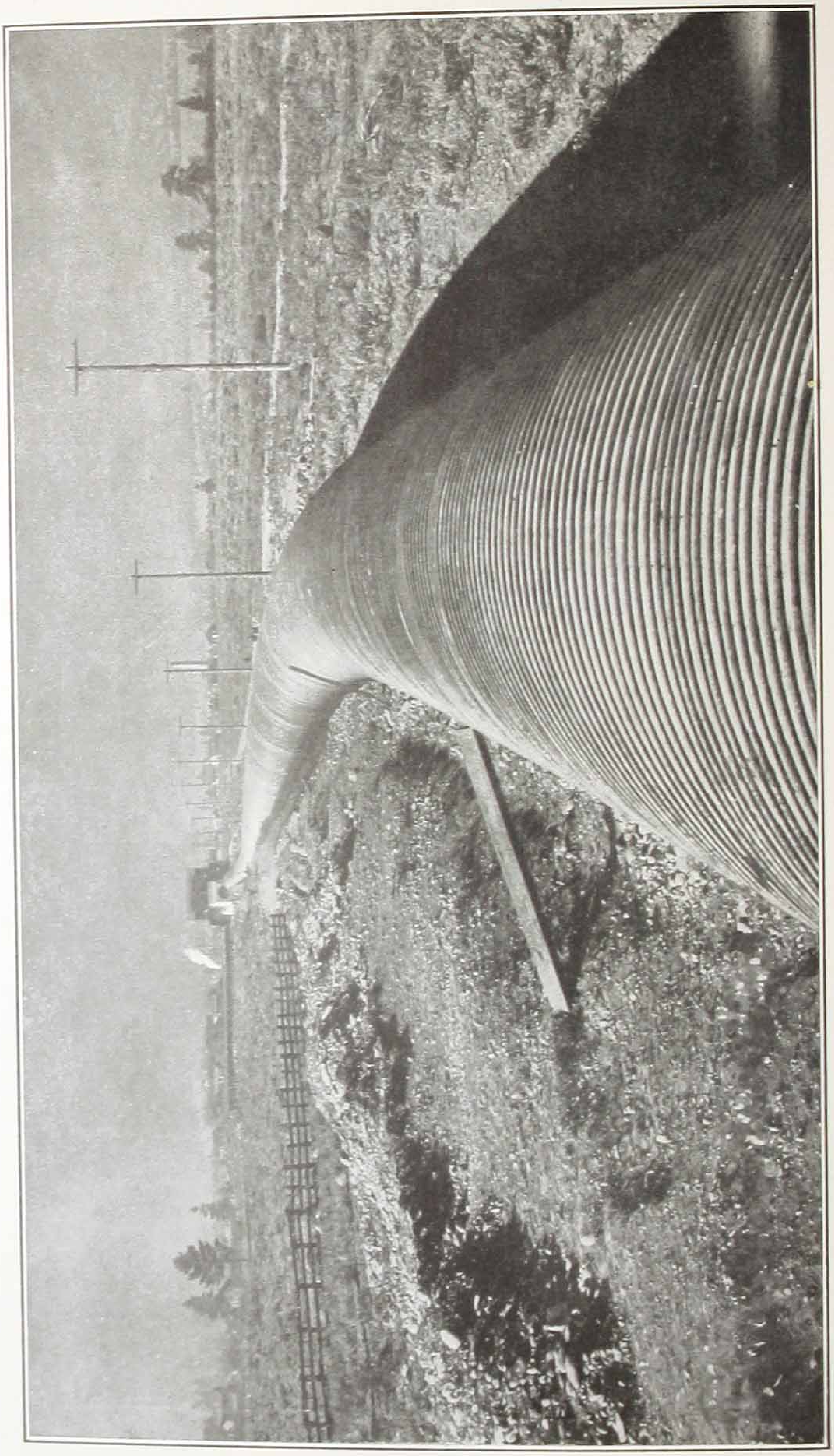
COMPARATIVE ICE FORMATION IN PIPE

Wood Flash Light Photos Steel





For fuller details see Page 21. Note the ice on the cast iron manhole cover in the wood pipe.



NEVADA

THIS view illustrates a Continuous Stave Wood Pipe 108″ in diameter, installed under the supervision of Stone and Webster Engineering Corporation near Verdi, Nevada, on the power development of the Truckee River General Electric Co.

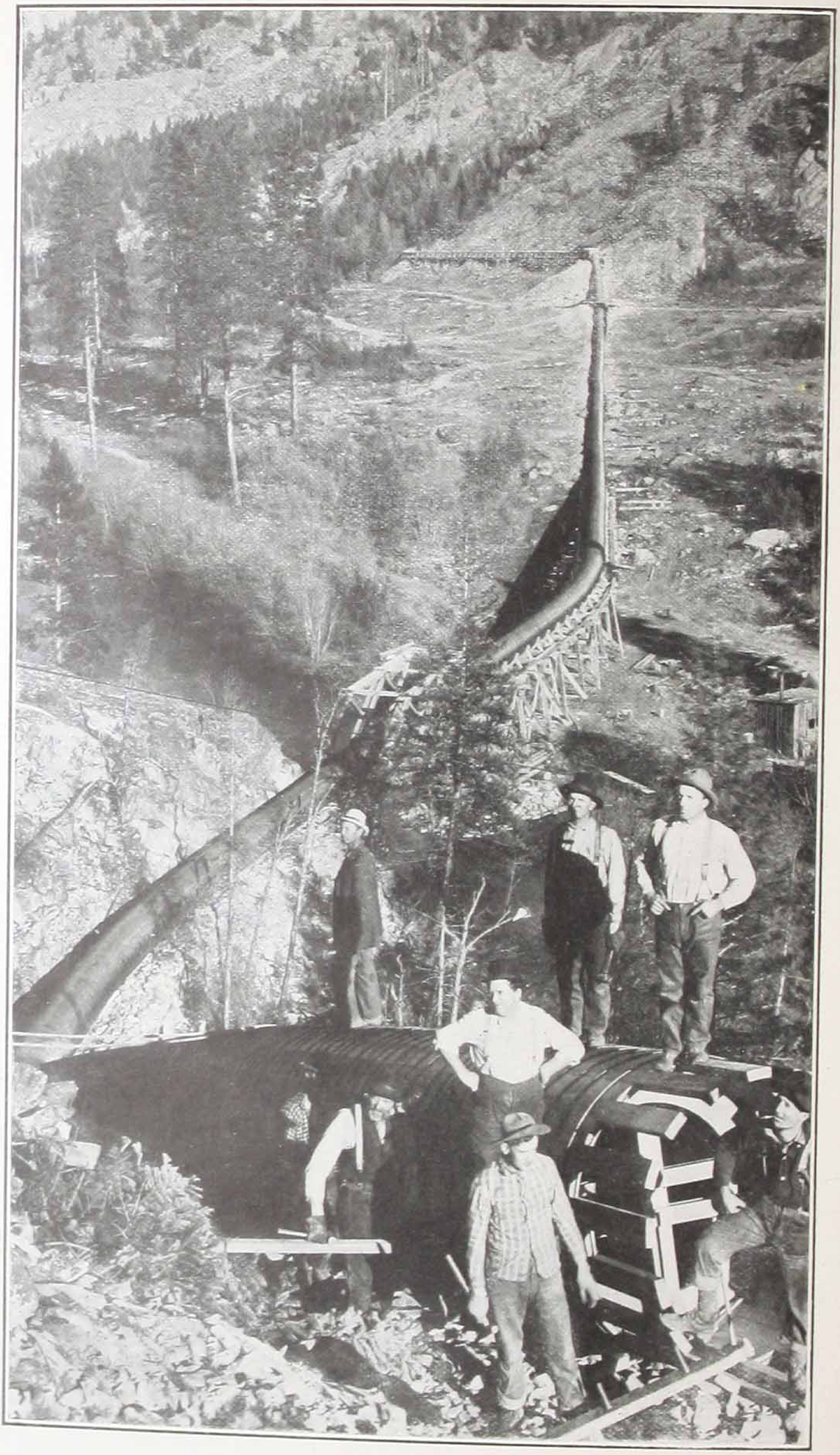
The wood pipe is the connecting link between a timber flume forebay and a riveted steel penstock.

This pipe was bedded to its horizontal diameter in selected backfill, the filling, in turn, being backed by an embankment of loose rock.

—————o—————

A COMPOUND PARADOX

Wood stave pipe has LONGEST life under the HIGHER heads, SHORTEST life under the LOWER heads. This is because low heads often give imperfect saturation of the staves whereas the complete saturation brought about by the higher heads gives such stave material as we use absolute immunity from decay under normal conditions. It is, therefore, best to locate wood stave lines, in so far as possible, so as to have a minimum head of at least twenty feet. Ordinarily nothing can be saved in the banding by locating under lesser heads than twenty feet, since under these low heads the spacing is arbitrarily fixed by mechanical reasons and not by the internal pressure due to the water.



MONTANA

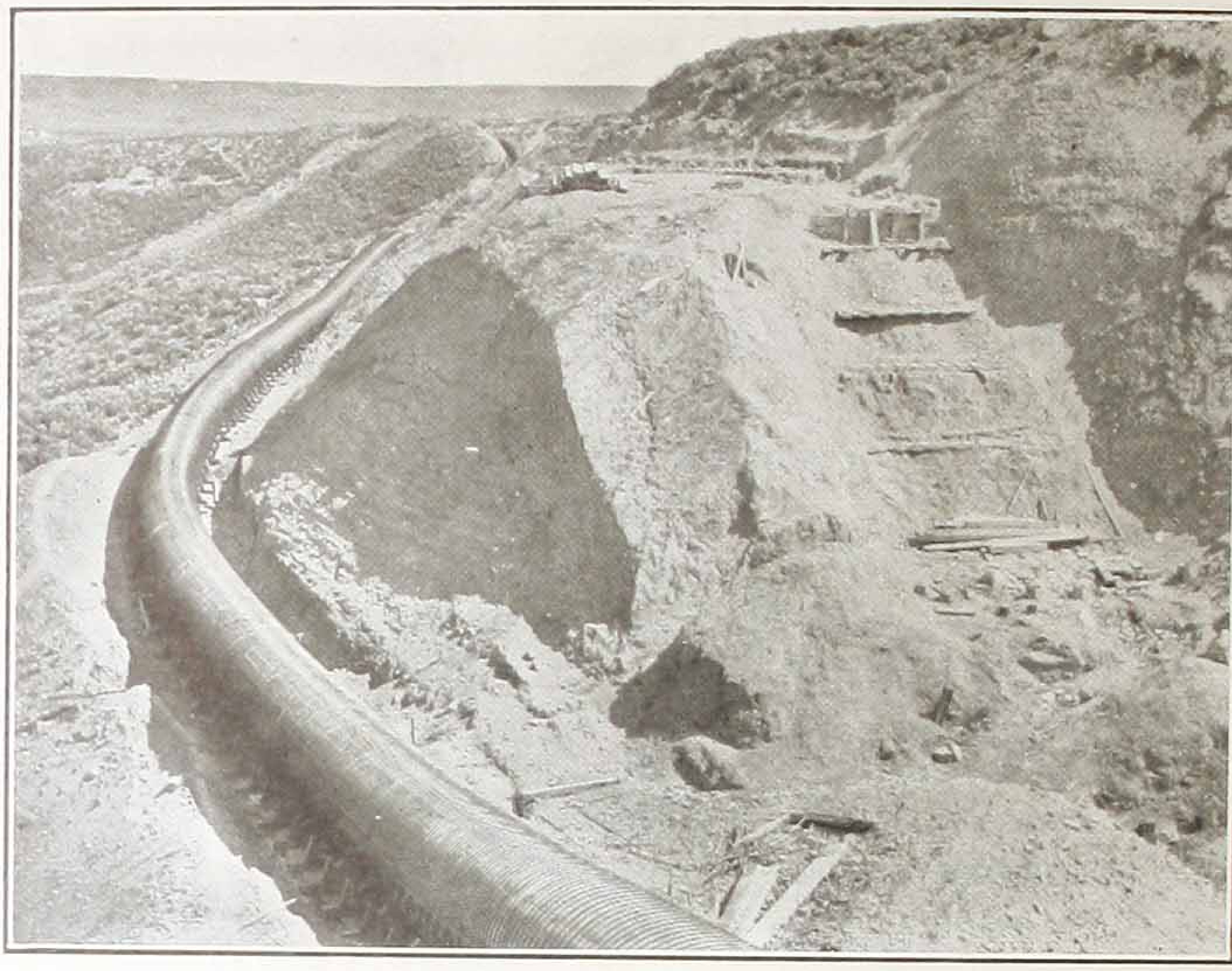
THE construction view on the opposite page shows a 60″ Continuous Stave Inverted Siphon installed by us on an irrigation project in Western Montana. This line conveys water across the river and is connected to timber flumes at either end.

QUOTATIONS

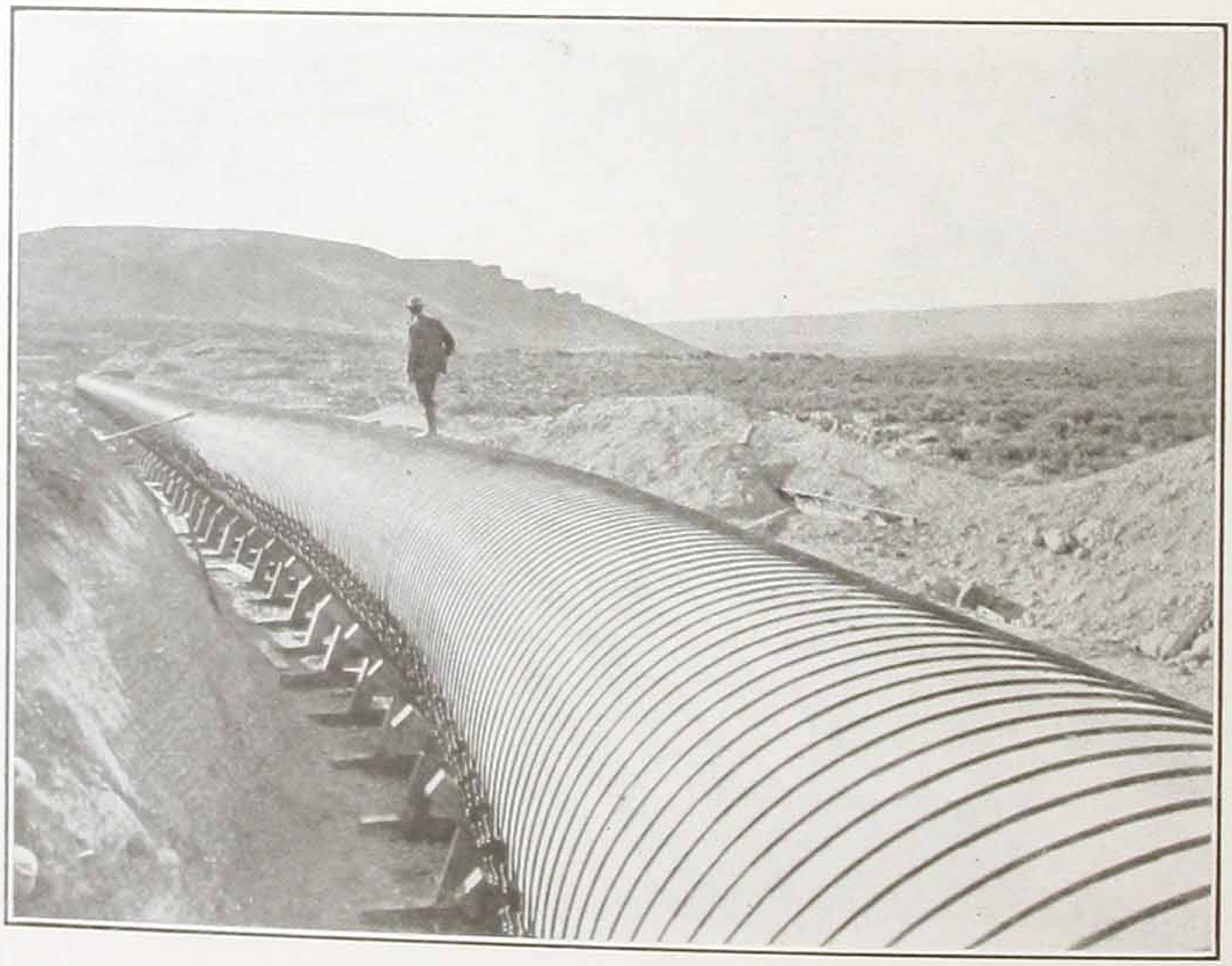
We are always pleased to furnish preliminary estimates or final tenders on your pipe requirements whenever wood stave pipe will satisfy the conditions imposed. WE HAVE NO PRICE LISTS. Every inquiry is given individual attention. The preparation of an estimate involves considerable work which we are glad to do if you meet us half way by giving us specific information regarding your conditions. To save both our time and your own, please give us as much of the information asked for below as is available.

(a) Inside diameter of pipe.
(b) Approximate length of pipe.
(c) Plan and profile (rough sketch will often serve).
(d) Use; viz: Penstock, Pump discharge, Inverted Siphon, etc.
(e) Quantity of water to be handled, horse power desired, etc.
(f) Name of railway station nearest proposed installation.
(g) Any additional data you have.

When requested, we shall be glad to make recommendations regarding the diameter of pipe required if sufficient information is given on which to base necessary computations. In most cases the diameter can be determined by referring to the diagram on Page 48.



Note the former location of the abandoned flume to the right



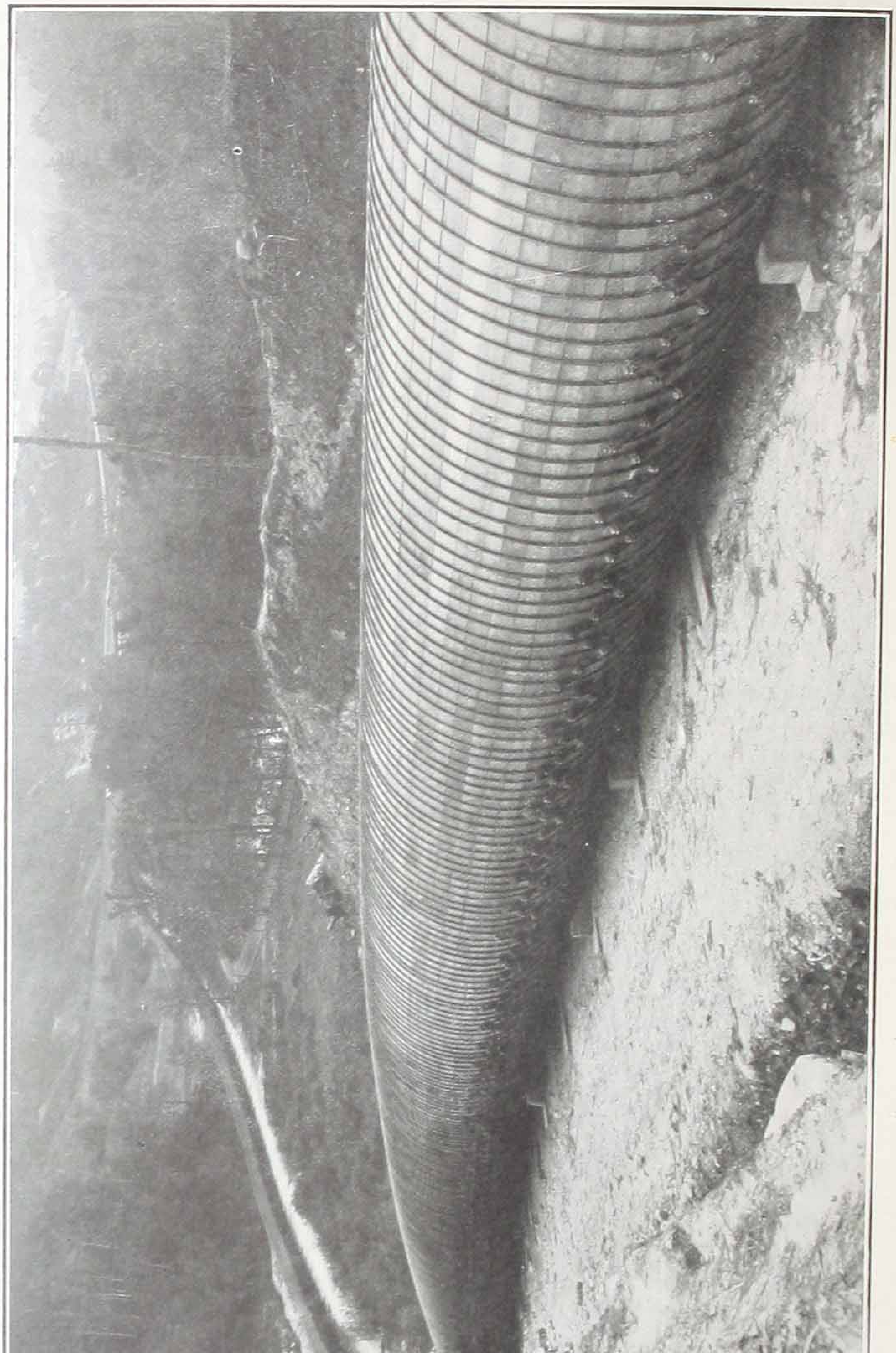
IDAHO

THE two cuts on the page opposite show a portion of a Southern Idaho irrigation project, on which we furnished fully fabricated materials for the construction of an inverted siphon of Continuous Stave Wood Pipe 100" in diameter, to replace a flume which, although of high grade standard construction, was made useless by the settlement of the bents due to the softening of the ground under the mudsills, brought about by the leakage incident to flume construction.

This replacement was made after two irrigation seasons had demonstrated the futility of all attempts to keep the flume in good repair. The saving in cost of construction had pipe been installed in the beginning is apparent.

Ask the fellow who has tried both methods of installing wood pipe as to which pays best in the long run; an installation made by an expert pipe contractor whose reputation depends entirely on this one class of construction or one made by the general contractor with his burden of divided energies and with no particular interest in the performance of the pipe line after acceptance.

Specials such as manholes, air valve connections and blow-off connections are readily attached to stave pipe by means of cast iron or cast steel saddles held in place by special bands. See illustration on Page 20.



FULTON COUNTY, NEW YORK

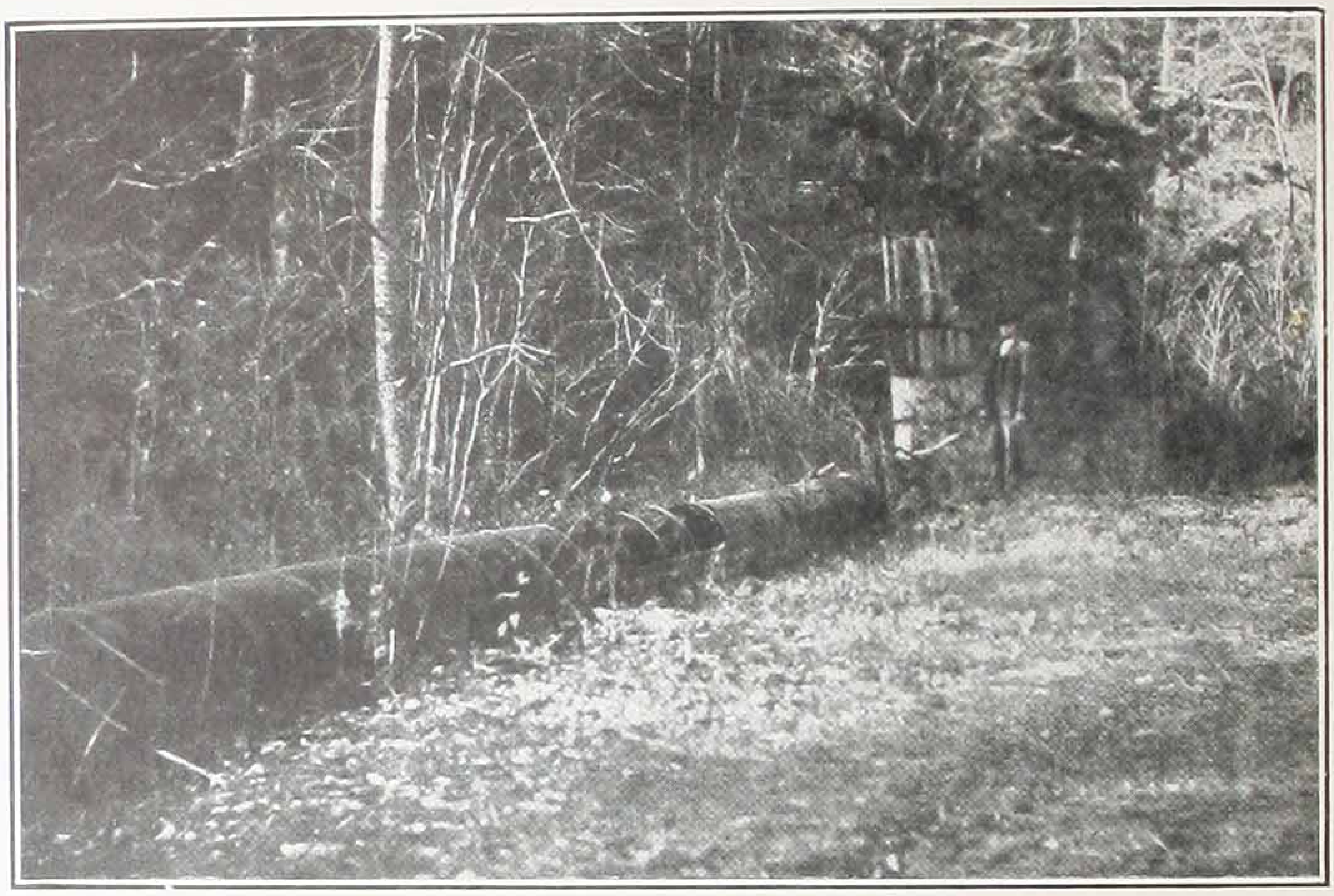
THIS view shows a portion of one of our 78″ Continuous Stave Wood Pipe power lines, approximately two miles long, carrying water from the dam to an open concrete surge tank. That portion of the line between the surge tank and the power house consists of a 96″ Continuous Stave Wood Pipe, serving under a maximum head of 160 feet. This installation is in Fulton County, New York, and represents the high type of construction which is our uniform practice.

This plant was designed and its installation supervised by Wm. Barclay Parsons, Consulting Engineer, 60 Wall St., New York. A full description will be found in Vol. 64, Page 627, of the Engineering Record of Nov. 25th, 1911.

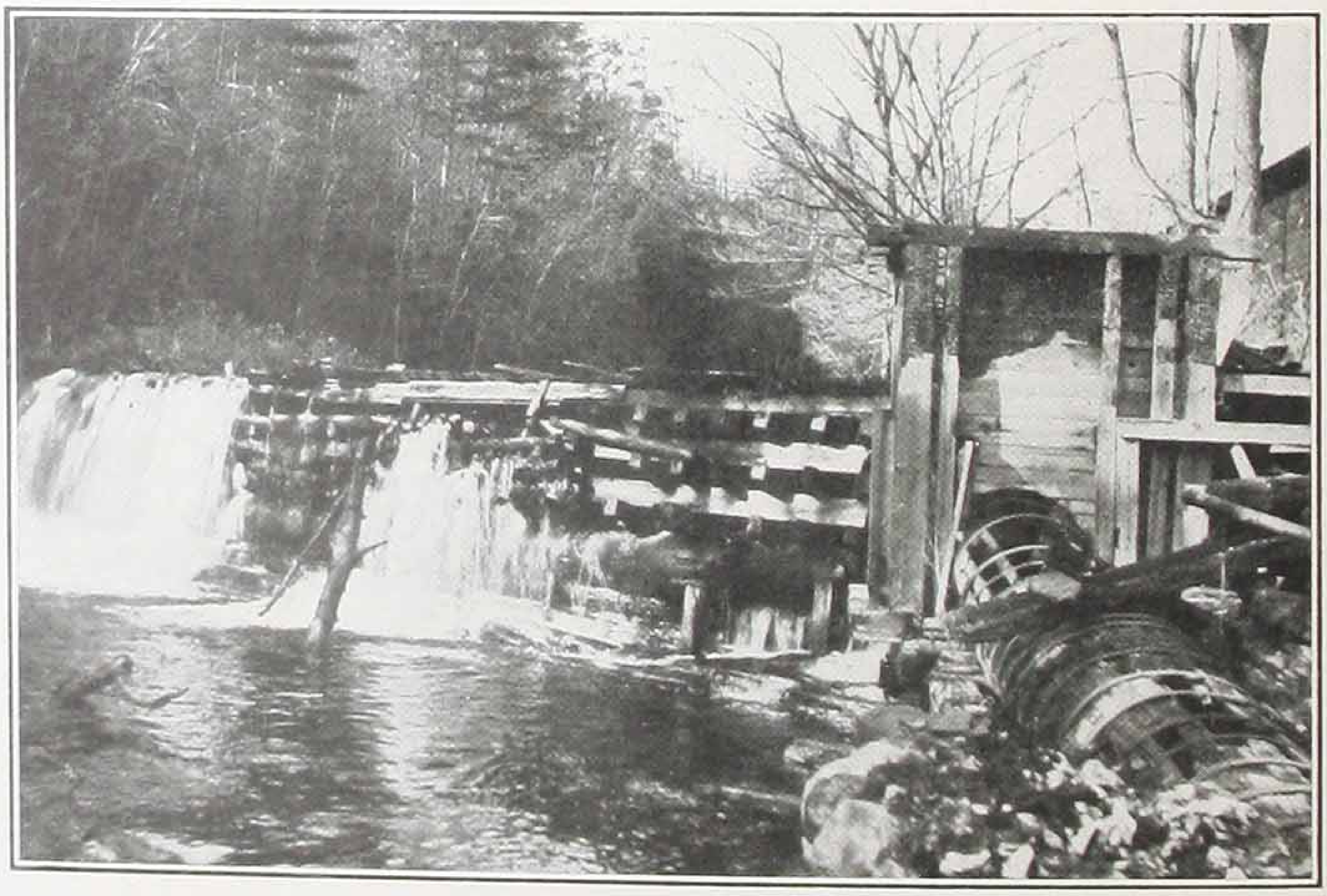
CURVES, ANCHORAGE AND EXPANSION

As a rough rule of thumb the minimum economical radius of curves for Continuous Stave Pipe may be taken as sixty diameters. Vertical and horizontal curves should not be planned in the same section of pipe and wherever possible a tangent should be introduced between curves.

Adequate anchorage should be provided to take care of water thrust at curves but no expansion joints are required since wood pipe does not expand or "creep" due to changes in temperature even if it becomes necessary to empty the pipe in extremely hot weather.



The Penstock



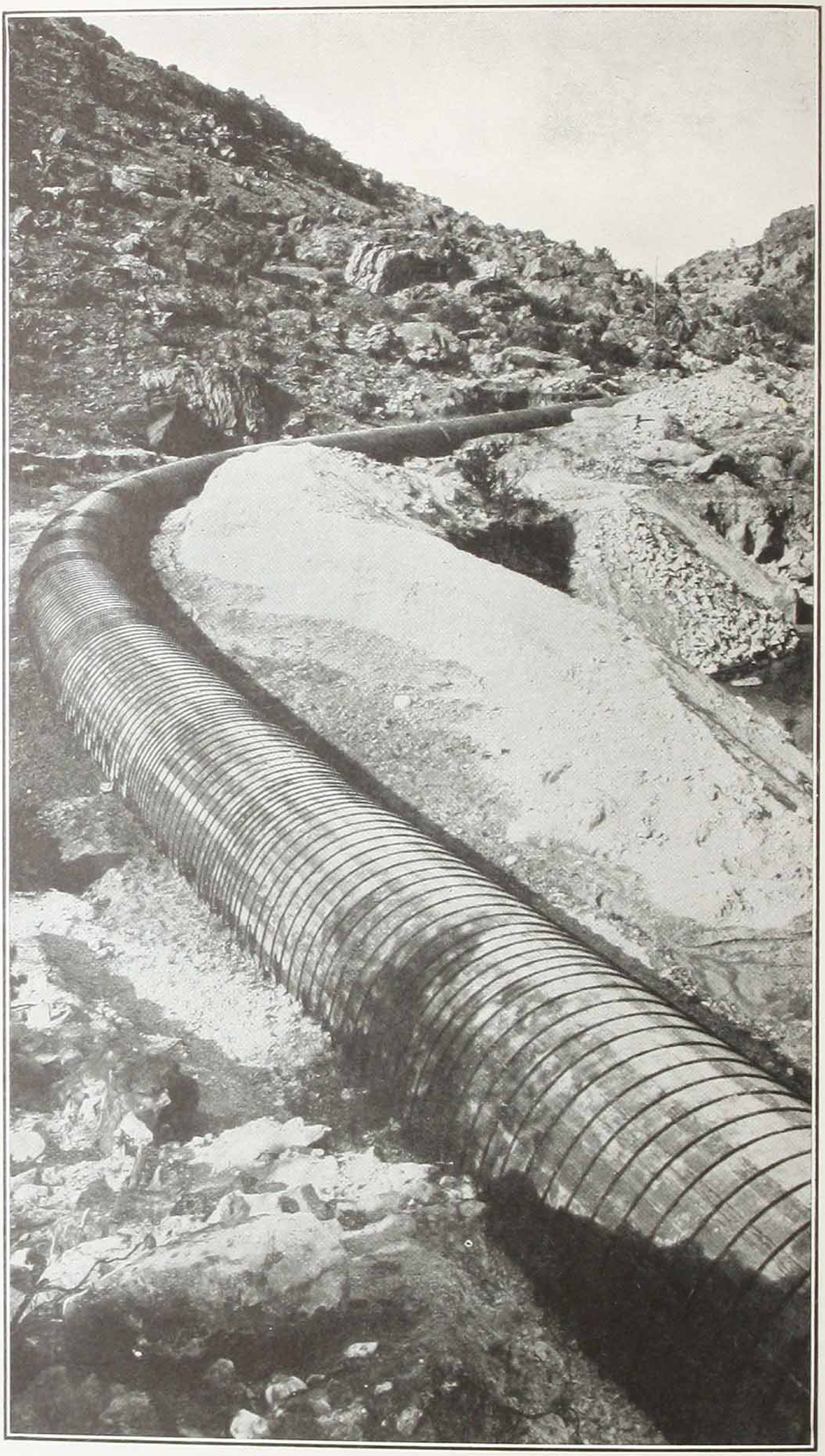
The Dam

FULTON COUNTY, NEW YORK

WE here present an historical and early instance of a wood stave penstock designed and built by a millwright about 1850 to serve a primitive water wheel, characteristic of the power development of those days. The line has fallen into decay since the burning of the mill about 1903.

This interesting installation served continuously for about 50 years, wherein depreciation was negligible and where accident and obsolescence only interrupted its economic life. There are at least two notable structural features on this power line. All pipe was laid on tangents. Where an angle was necessary, a wood stave stand pipe was used, thus serving at once as an angular band and a surge or vent pipe. The bands were 2″ hoops, No. 16 gauge, and are yet excellently preserved, due largely, perhaps, to the fact that the metal was old-process puddled iron. The staves were scantlings jack planed on their edges to the proper bevel, thus assembling into a many-sided polygon.

The view shown on page 30 is that of a modern, larger, high-head installation, which without the burning of the mill would have rendered the old plant obsolete. The new project with its greater head includes that portion of the stream (the Garoga River) formerly used by the ingenious millwright. Our representative, in searching for information regarding the old mill, encountered the "oldest inhabitant"—a storekeeper for 50 years within three miles of the mill. He said he had "never been over that way in day-light." "Ye see, it's this way, when the boys was small, I was held purty close to the store, and now that they have growed up, they don't spell me much."



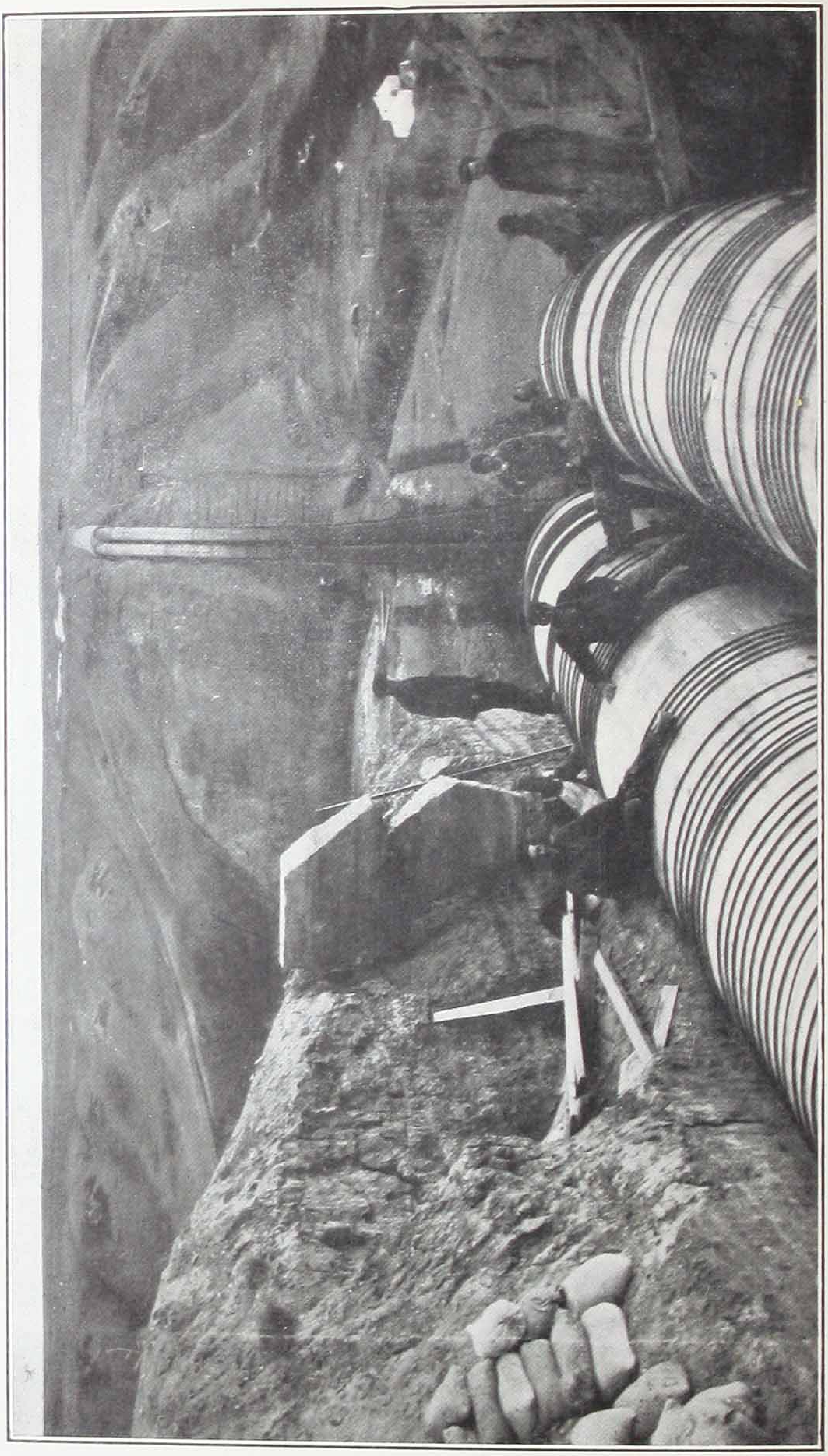
COLORADO

WE here show a section of approximately four miles of 84″ diameter Continuous Stave Wood Pipe installed by us in Southern Colorado for conveying water from the diversion dam to the head of the canal system of the Pueblo-Rocky Ford Irrigation Co. (See Engineering Record of November 18th, 1911, Vol. 64, Page 602.)

The adaptability of Continuous Stave Construction to rugged topography should be noted. Many such situations can be treated economically and permanently only by the use of wood pipe, while less permanent forms of construction are too often ill advised and poor engineering.

While as a general rule, curves should not be planned having a radius of less than about sixty diameters so as to keep the friction losses and cost at a minimum, it is possible, with skilled workmen and selected material, to get around considerably sharper curves, the limit depending largely on local conditions. On this line some very sharp curves were built on force account, one having a minimum radius for a short distance of about 140′.

Our curves are perfectly smooth and do not consist of a series of short chords.

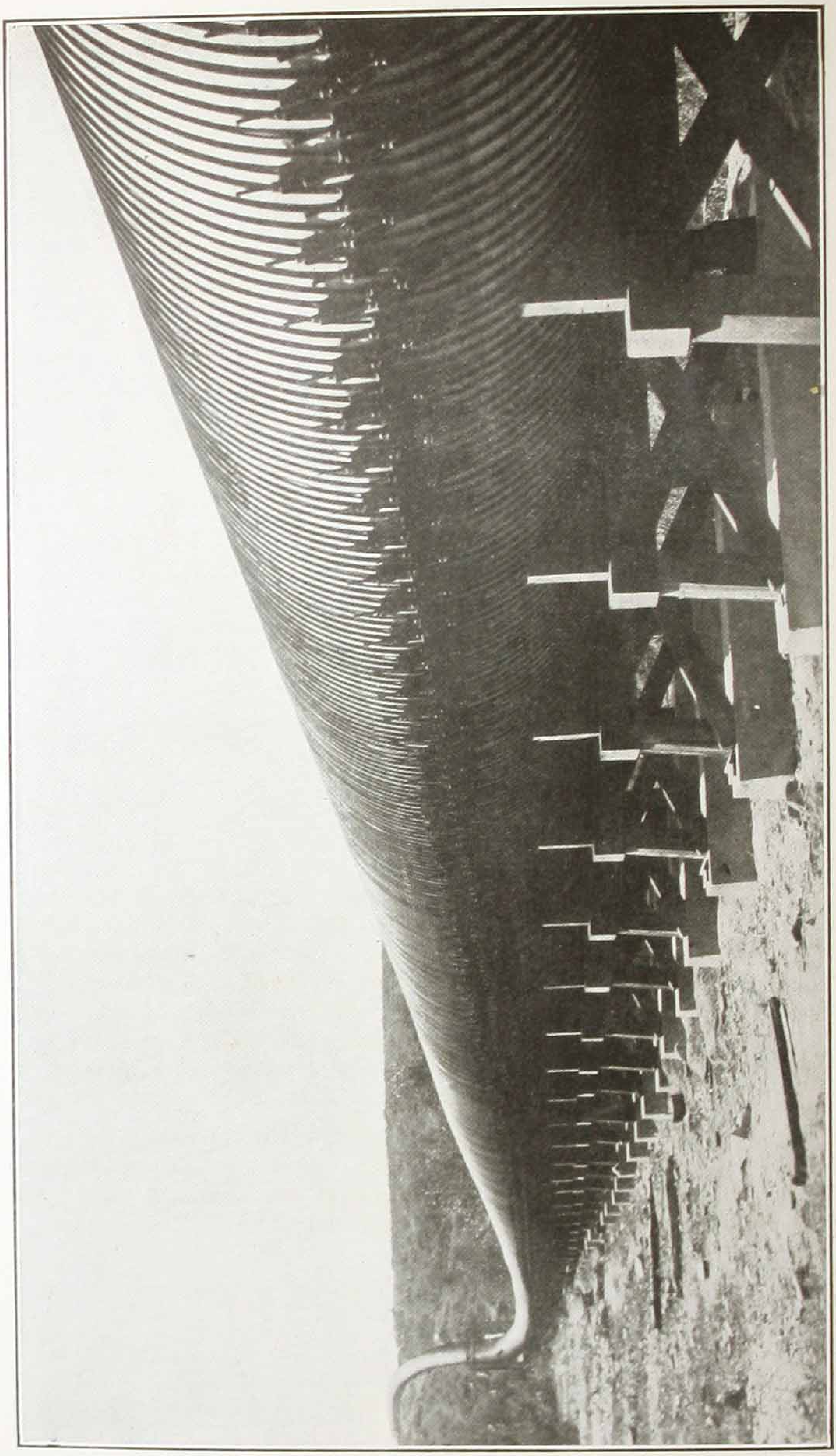


ALBERTA, CANADA

THIS view shows one of our twin inverted siphons, 90" diameter, of Continous Stave Wood Pipe, used for carrying water across an intervening valley between the fertile bench lands of the Southern Alberta Land Co., Ltd., in Western Canada. The economy and good engineering in the use of such cut-offs is apparent when without their use, long stretches of supported flume and sinuous ditch construction would have to be used in getting around the head of such depressions.

This project is unique in that the water is to be used for irrigating grazing and grain lands in a semi-arid region. A description of the main structural features may be found in the Engineering Record of May 27th, 1911, on Page 590 of Vol. 63.

We have always fulfilled our promises in regard to time of completion and our work has always been so carefully done as to entail no delay at time of test and no dissatisfaction afterward. Can you afford to risk tying up your plant for an indefinite period of delays and repairs by accepting the proposal of an inexperienced and irresponsible bidder?



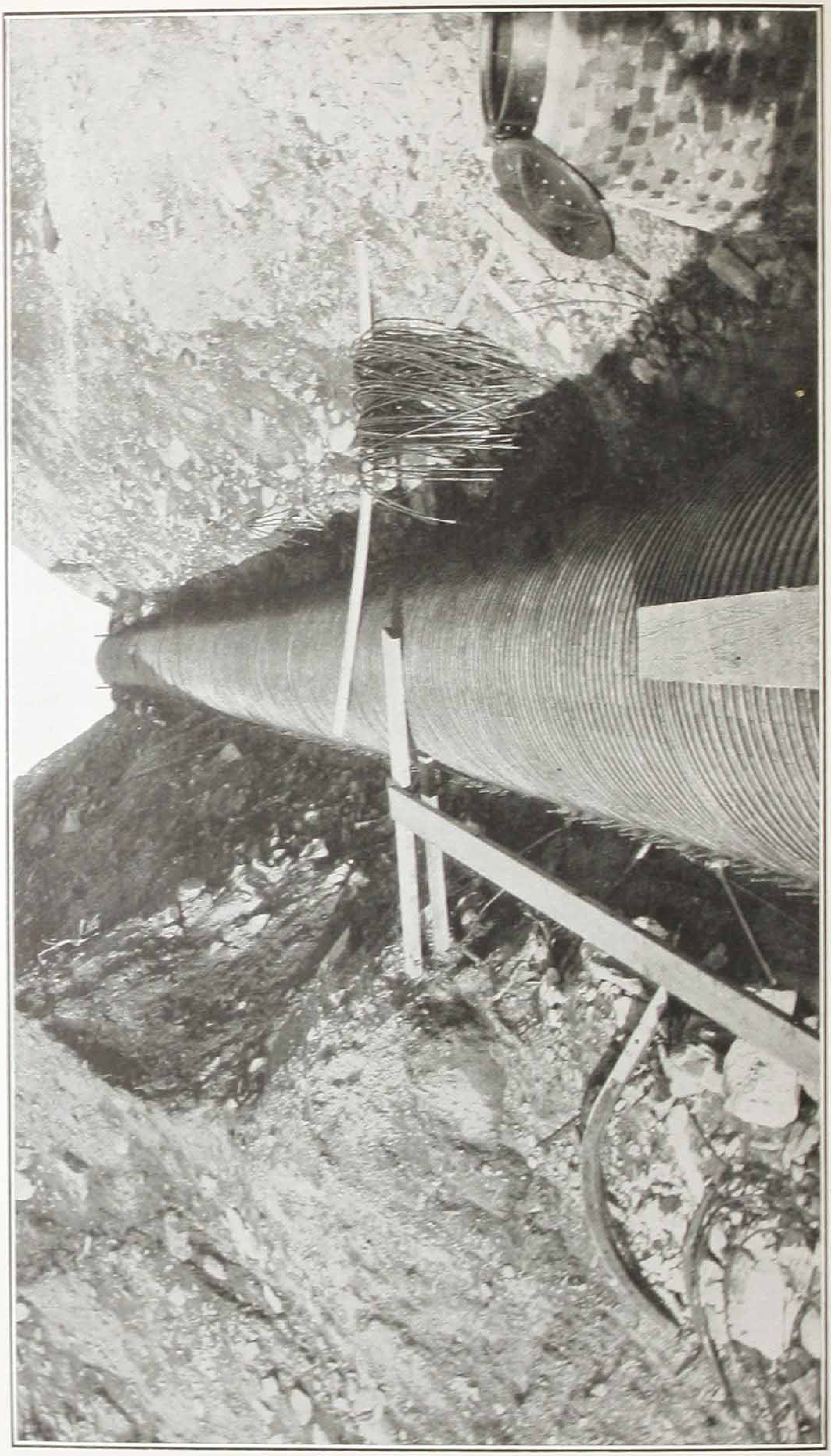
IDAHO

WE here show one of our 65″ Continuous Stave Wood Pipe Irrigation Lines at Teton in Eastern Idaho. Note how readily this type of pipe lends itself to simple and efficient sub-structure design.

REGARDING STAVE MATERIAL.

We believe Douglas fir is the finest timber grown for pipe stave stock, and our plant is located in the center of that superior fir found only on the Pacific slope in the State of Washington. Other kinds of timber have been tried for pipe construction to a greater or less extent, but Douglas fir is rapidly coming into almost universal use. Every foot of stave stock that we ship is carefully scrutinized by practical and experienced inspectors, who have been in our employ for many years and we always welcome competent inspectors representing the interests of our customers. We handle nothing but high-grade pipe and tank stock and are not in the general lumber business, hence we have no culls, seconds or rejects to dispose of to our customers, because such material is turned down by our inspectors at the sawmill and never reaches our plant.

Our Machine Wire-wound Wood Stave Pipe is made from the same high grade material. We are always pleased to submit specifications to prospective buyers for their approval and guidance. Our experience in these matters is at your disposal for the asking.



UTAH

THIS view illustrates a 74" diameter Continuous Stave Line installed in Utah for power purposes.

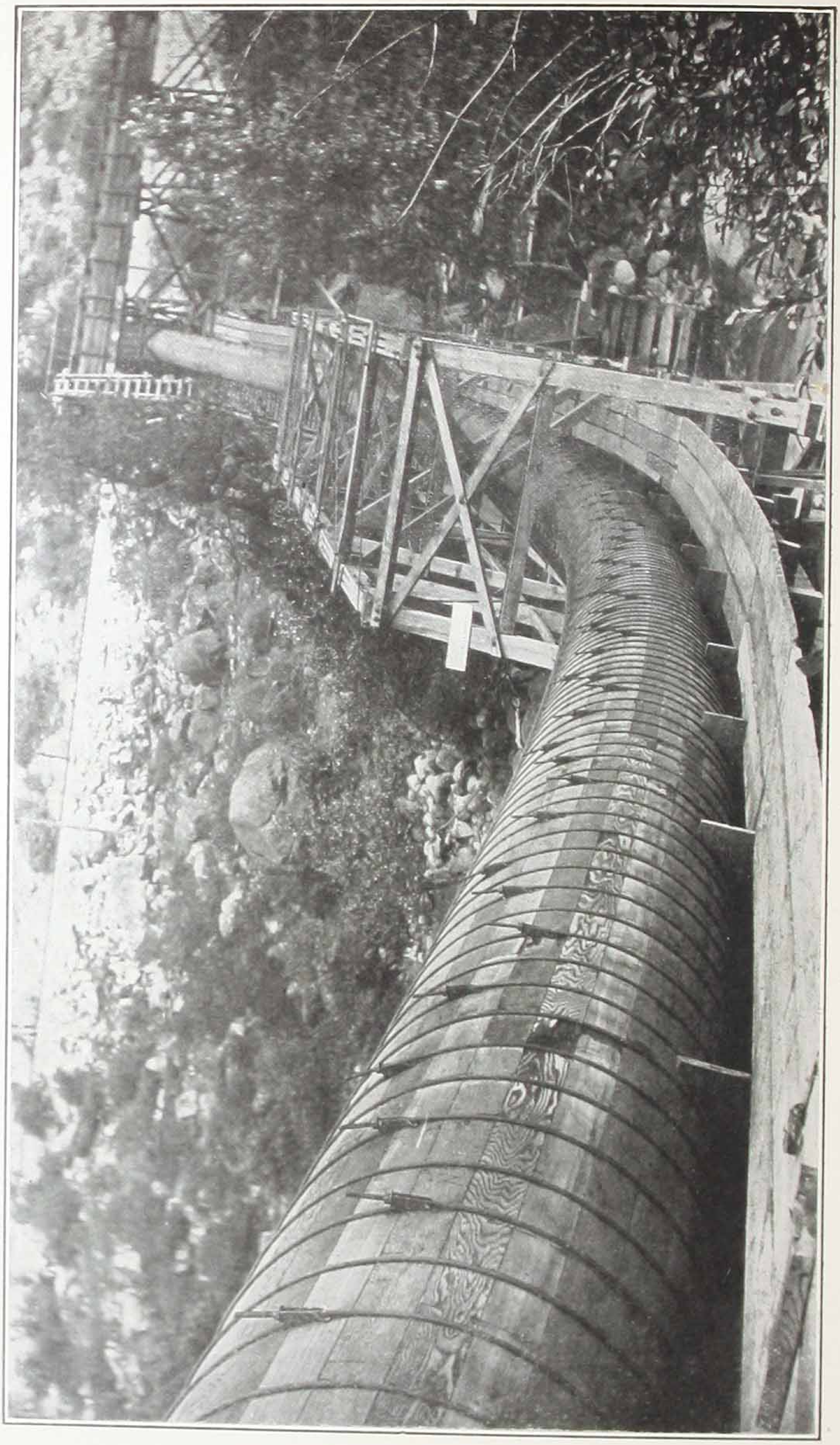
DIAGRAM FOR DETERMINING FRICTION LOSSES, ETC., IN WOOD STAVE PIPE

On Page 48 (the end of the book) we present a logarithmic diagram from which can be determined by inspection the relation between discharge, loss of head due to friction and velocity in wood stave pipe from 2 to 14 feet in diameter.

This diagram is based on the Hazen-Williams exponential formula $v = C\, r^{0.63} s^{0.54}\, {}_{0.001}{}^{-0.04}$. For "C" a value of 130 is used. The use of this constant gives friction losses slightly greater than those reported by Mr. E. A. Moritz in the Transactions of the American Society of Engineers, Vol. 74, Page 411. Mr. Moritz has made the most extensive and careful experiments on wood pipe reported to date and has verified his results by additional observations since the presentation of his paper. These experiments were carried on by Mr. Moritz under authority of the United States Reclamation Service and hence were made by disinterested observers and are worthy of the most careful consideration.

The following brief directions should make the method of using the diagram clear to those unfamiliar with this method of presentation. Along the left margin is shown the discharge in cubic feet per second ranging from 10 to 2000. Along the bottom is shown the loss of head in feet per 1000 feet of pipe due to friction, ranging from 0.1 to 10; this also represents the slope of the hydraulic gradient. One set of diagonals represents various sizes of stave pipe from 24" to 168" in diameter. The other set of diagonals represents velocities in the pipe of from 2 to 10 feet per second. Supposing it is desired to know what size of pipe should be installed to deliver 40 second feet with a friction loss of 3.5 feet per 1000. Follow the horizontal line from 40 at the left to where it intersects the vertical line from 3.5 at the bottom (see dashed lines). This intersection is just below the diagonal for 34" pipe, hence this is the size required. The velocity in the pipe is evidently about half way between 6 and 7 or about 6.5 feet per second.

The diagram applies to pipe that is practically straight. Allowance should be made for excessive curvature, also for velocity and entry heads.



WASHINGTON

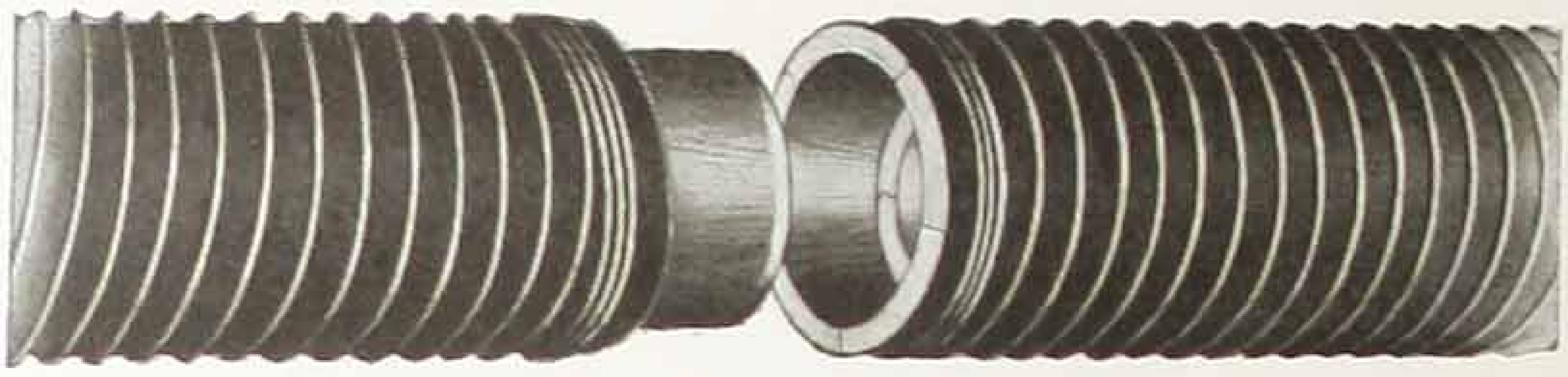
THIS view illustrates one of our 48″ inverted siphons of Continuous Stave Wood Pipe, used to convey water for power purposes between flumes on opposite sides of the Wenatchee River, near Leavenworth, Washington. This siphon is notable in that it is built entirely on the arc of a circle having a radius of 250 feet, and is supported on trestle and a Howe truss span.

REGARDING BANDS AND SHOES

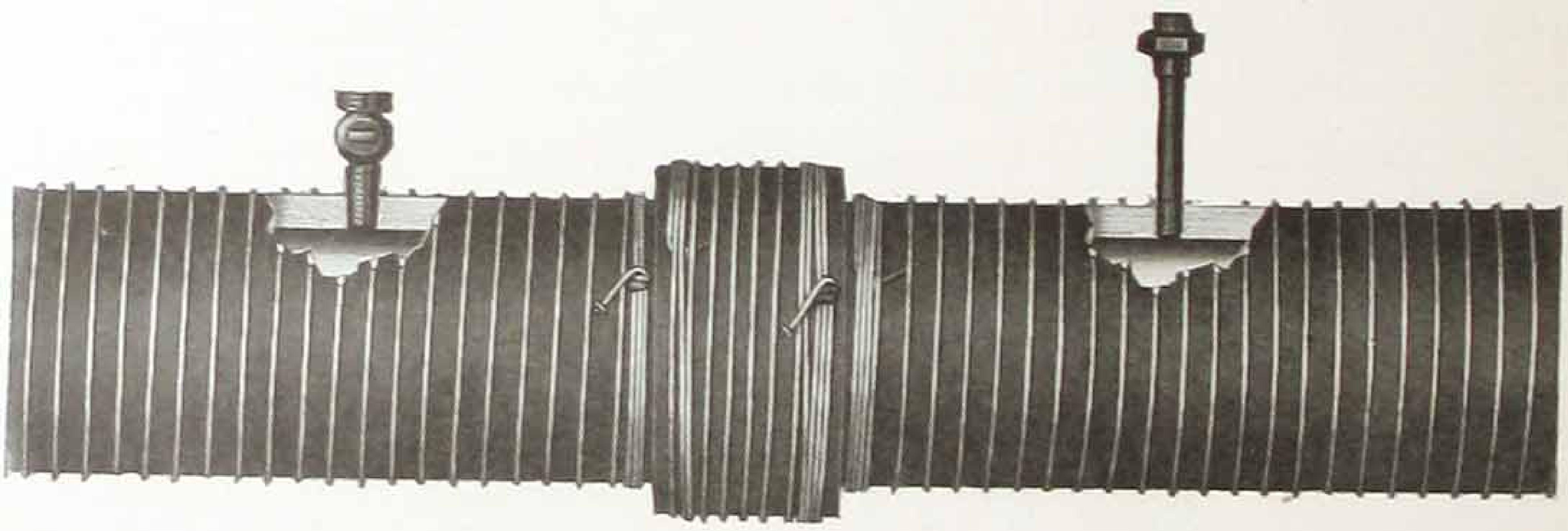
Mild steel having an ultimate strength of from 58,000 to 68,000 lbs. per square inch and an elastic limit of not less than one-half the ultimate strength is best adapted for use as pipe bands. The button heads on the bands, as specified by us, will develop the full strength of the band when pulled through a "U" slot similar to the slot in the pipe shoe. The threads are fabricated by the cold rolling process, giving an upset of about 1/16″ and are guaranteed to be as strong as the body of the band. We use hex. nuts and washers of generous dimensions and the bands are bent to the proper radius and dipped at the rolling mill before shipment.

The shoes are made of the best grade of malleable cast iron, after our own exclusive designs, and will develop the ultimate strength of the band under working conditions, and not merely its elastic limit, as is the case with many stock shoes. Shoes are hot dipped at the foundry before becoming rusty.

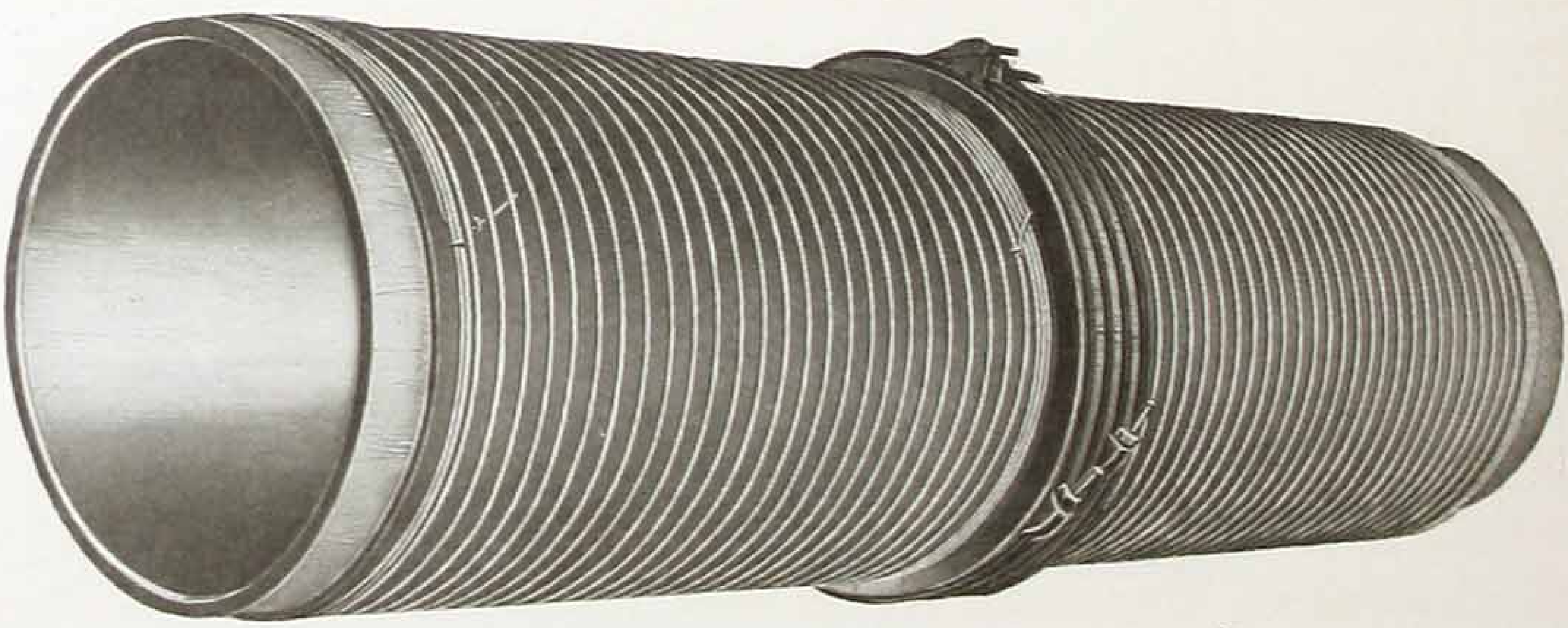
The bands and shoes used on the individual banded couplings for Machine Wire-wound Pipe, illustrated on Page 44, are of the same type as those used on Continuous Stave Pipe. The bands are of the proper diameter to conform readily to the coupling and the nuts and threads are practically "fool-proof." We use malleable cast shoes exclusively.



Inserted Joint



Wire-Wound Coupling



Individual Banded Coupling

MACHINE WIRE-WOUND PIPE

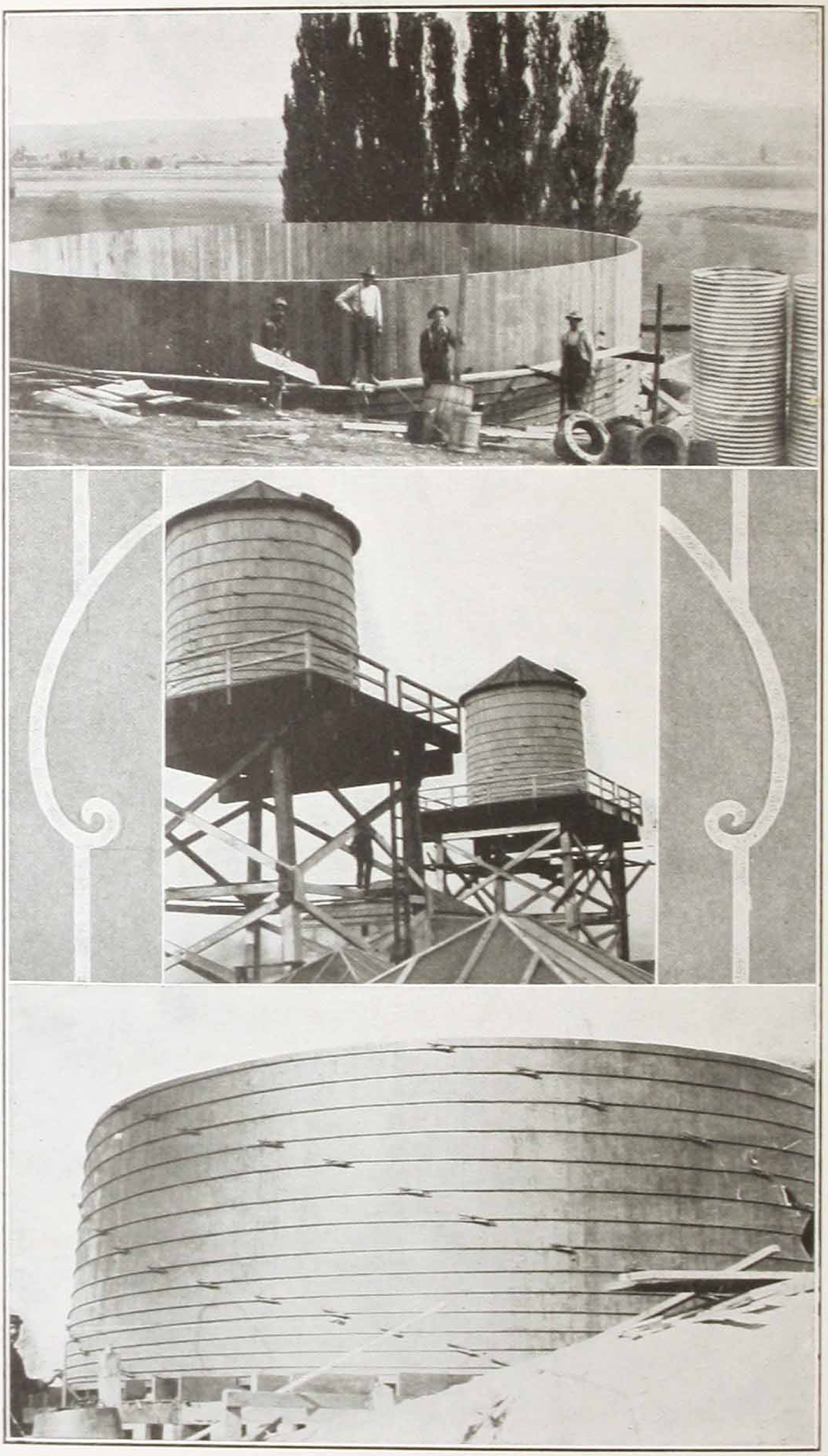
THIS type of wood stave pipe is manufactured in standard sizes of from 2 to 24 inches inside diameter, and in even foot lengths of from 8 to 20 feet.

The three types of couplings used are illustrated on the page opposite. The inserted joint type is best adapted to pipe up to and including 8 inches in diameter to serve under heads of 250 feet and less and for pipe from 10 to 14 inches in diameter to serve under 150 feet and less, depending somewhat on local conditions. The wire-wound coupling type is used for pipe up to and including 12 inches in diameter and for higher heads than those for which the inserted joint type is suitable. The individual band coupling is used for all classes of wire-wound type 14 inches and upward in diameter.

Pipe having either of the first two types of coupling is shipped with a coupling in place on one end of each length and is laid by being driven together by a maul or ram acting as a "tompion" inverted in the end of the pipe to protect it.

Pipe having individual band couplings is shipped, ordinarily, with couplings separate. It is laid by slacking off the band nuts enough to allow the tenon on the pipe to slip into place in the coupling. The nuts are then tightened enough to cinch the bands tightly on the coupling, the tension in the band being distributed evenly by tapping the band with a hammer at different points around the coupling as it is being cinched.

The outside of all wire-wound pipe and couplings is treated to a thorough hot asphaltum base dip and rolled in fine sawdust before shipment. For the sake of clearness, this coating is not shown in the illustrations.



WOODEN TANKS

OUR tank department manufactures wooden tanks of all sizes and types, and we furnish skilled labor for erecting at a reasonable cost.

In the remodeling of our plant we are providing enlarged space to care for the growing demand of this trade.

We are always glad to quote on either regular or special work in this line.

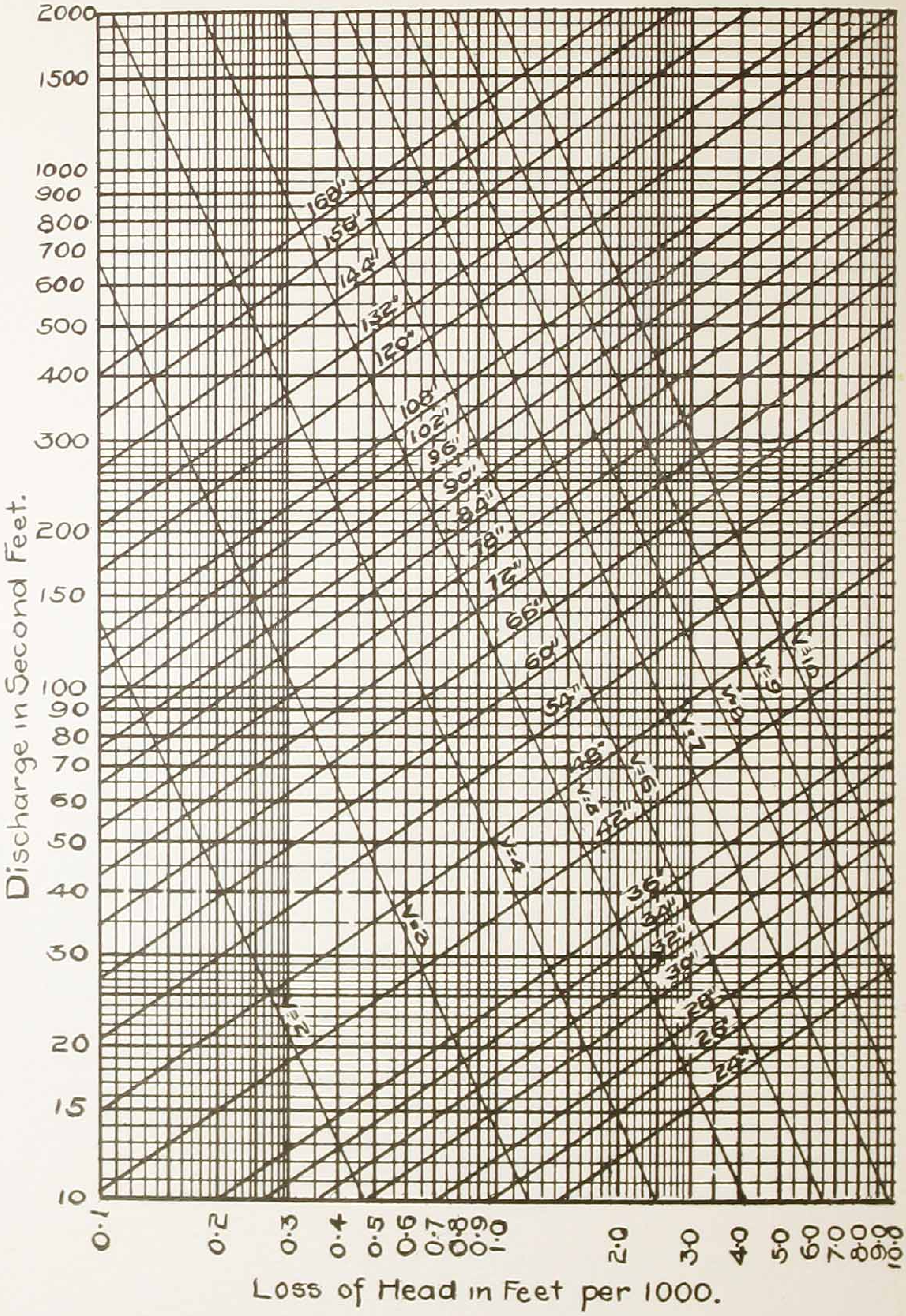
COMPARATIVE FRICTION LOSSES PER 1000′ IN CONTINUOUS STAVE and RIVETED STEEL PIPE

At velocity of 6 feet per second.

Diameter	Wood	Steel	Diameter	Wood	Steel
24″	4.5′	5.6′	96″	.90′	1.22′
36″	2.8′	3.8′	108″	.78′	1.07′
48″	2.0′	2.7′	120″	.69′	.94′
60″	1.55′	2.12′	132″	.62′	.84′
72″	1.25′	1.71′	144″	.56′	.76′
84″	1.05′	1.43′	156″	.51′	.69′

The vital importance of this saving on low head power developments and pump discharge lines is very evident.

DIAGRAM FOR FLOW OF WATER IN WOOD STAVE PIPE



EXAMPLE: Given discharge 40 second feet, friction loss or hyd. gradient 3.5 feet per 1000. Required diameter of pipe and velocity.

SOLUTION: Follow the horizontal line from 40 at the left to its intersection with the vertical line from 3.5 at the bottom. This intersection is just below the diagonal for 34″ pipe hence this is the diameter required and the velocity is about half way between V=6 and V=7 or about 6.5 feet per second.

(For full explanation see Page 41.)